UNITED STATES NAVY
M-TYPE AIRSHIPS

DESCRIPTIVE SPECIFICATIONS

Issued: June, 1944

4430

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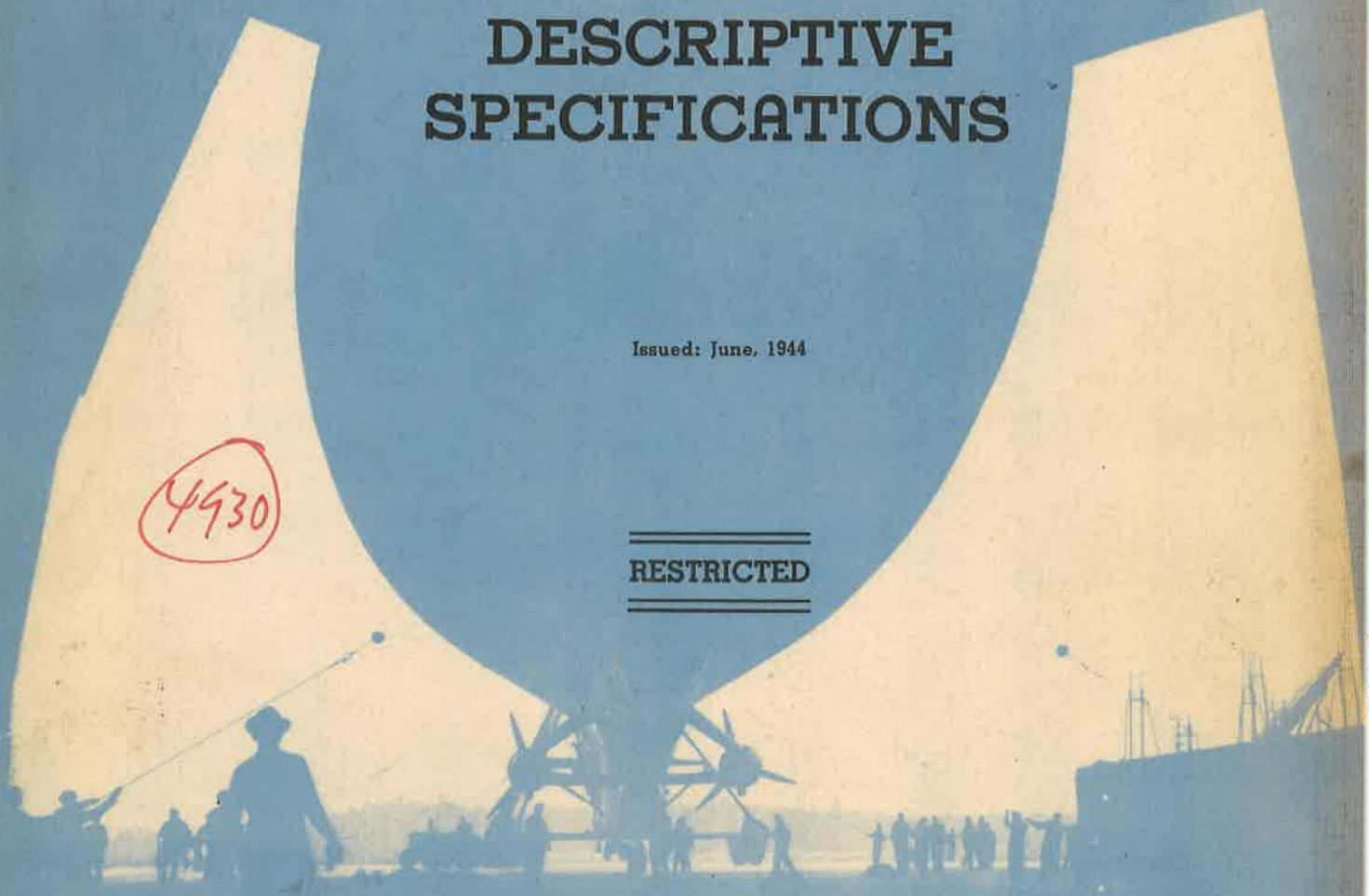

CONTRACT NOa(s) 146

GOODYEAR AIRCRAFT CORPORATION, AKRON, OHIO

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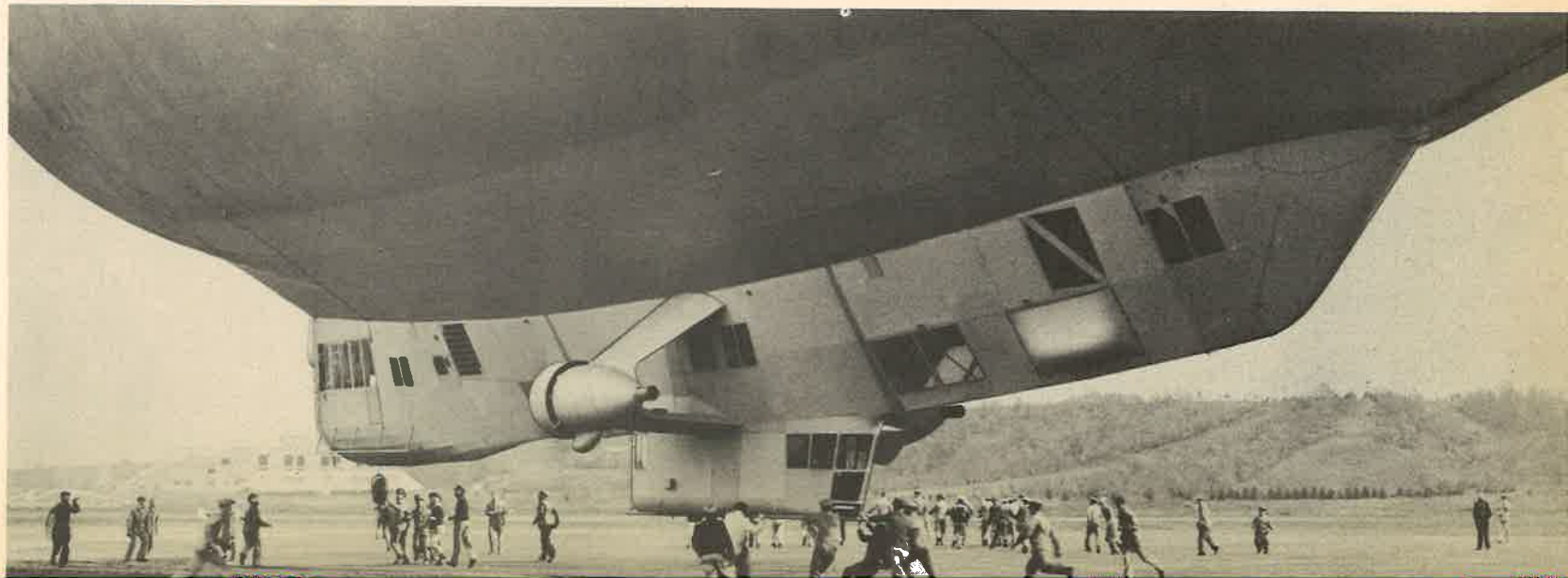

PREFACE

This manual summarizes the descriptive specifications of the M-Type airships as delivered to the U. S. Navy under contract NOa(s)146.

The information presented is intended to cover all major details. Minor details not described in the text may be found in the Goodyear Aircraft production drawings to which reference is made throughout the treatise.

Unless specifically noted otherwise, details given apply to the airships M-1 through M-4 as originally designed and constructed. Revisions and ammendments will be made only in case of significant changes in future construction.

Goodyear Aircraft Corporation welcomes constructive criticism of this manual. Invitation is therefore extended to all Navy Personnel to submit any corrections or suggestions for the improvement of this publication.

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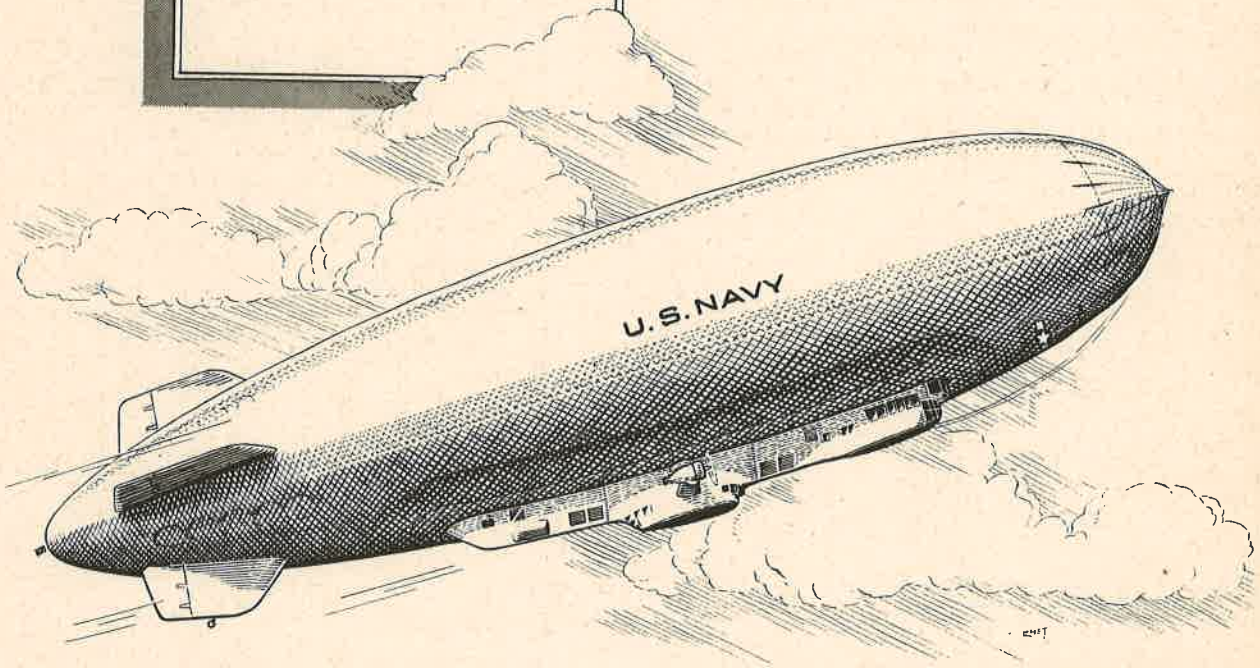
Part I

General Characteristics



Goodyear "M" Airship

- GENERAL CHARACTERISTICS -

A. GENERAL DESCRIPTION

The M-Airship has a streamlined, non-rigid envelope made of rubberized fabric, with all the usual accessories attached. The envelope contains four ballonets, one forward, one aft, and two amidship. The two center ballonets are inter-connected by two transverse ducts, which enable the ballonets to maintain equal pressures and act as a unit. The center of displacement of the total ballonet volume coincides with the center of buoyancy longitudinally, as does the displacement center of the center ballonets. This ballonet arrangement makes it possible for the ship to be operated as a single ballonet airship most of the time. All ballonets have connecting airlines and valves for controlling the pressure within the envelope. The normal operating gas pressure in the envelope while in flight is approximately two inches of water as read on the gas manometer in the car.

The fins and control surfaces are located in the vertical and horizontal longitudinal planes of the airship. They are constructed of aluminum alloy framework, covered with fabric doped in place. Rudders and elevators are of the balanced type.

The car consists of three articulated sections connected by universal joints. The forward section houses the operating, navigating, and service facilities; the center section supports the power plants and a suspended blister; while the after section carries, principally, fuel and ballast containers and the aft bomb loads. The center and after sections are of more or less triangular cross section, apex downward, with a catwalk extending along the keel.

The car is constructed of welded chrome-moly steel tubular framework covered with aluminum alloy sheeting and cotton fabric.

The car is suspended from the envelope by an internal and external suspension system, utilizing three catenary curtains which distribute the car load along the upper and lower parts of the envelope.

The consumable loads such as fuel, oil, and water are distributed about the center of buoyancy so that they will affect no appreciable change in trim during normal flight operations.

Three landing wheels are provided. The main landing wheel, housed in the blister, is located slightly aft of the center of buoyancy. A smaller, swivel-type landing wheel is placed under the forward car section to protect same when the ship noses down. The third and smallest auxiliary landing

wheel is located on the outboard edge of the lower fin structure.

The bow stiffening and mooring unit incorporates improved nose cone and batten design, and is of the semi-rigid type. The nose cone is constructed of aluminum alloy channels riveted together and covered with fabric. Thirty-two wooden battens are radially and equally hinged to the outboard edge and are secured to the envelope at their after ends by finger patches. A standard type steel mooring cone and spindle assembly secures the ship to the mast.

B. DIMENSIONS

	M-1	M-2, 3 & 4
1. Overall Dimensions - Feet		
Height	89.1	89.1
Length	287	293.5
Width	71	71
2. Envelope		
Theoretical:		
Volume, Cu. Ft.	625,500	647,500
Surface Area, Sq. Yds.	5,140	5,290
Length, Ft.	284	290.4
Fineness or Slenderness Ratio	4.3	4.39
Maximum Basic Diameter	66	66
Maximum Section from Bow, Ft.	113.60	116.8
Center of Buoyancy from Bow, Ft.	129.76	132.9
Center of Air Ballonet Volume from Bow, Ft.	128.9	131.5
Cylindrical Coefficient	.6438	.652
3. Ballonets		
Volume - Cu. Ft.		
Forward	39,600	44,100
Center (2)	103,600	103,600
Aft	41,500	45,900
Total Volume	184,700	193,600
Percent Envelope Volume	29.5	29.9
4. Area Empennage Surfaces - Sq. Ft.		
Horizontal Fins (2) Each	473	473
Elevators (2) Each	167	167
Vertical Fins (2) Each	319	319
Rudders (2) Each	169	169
Total Area of Tail Surfaces	2256	2256

C. WEIGHTS AND LIFTS - LBS.

	M-1	M-2	M-3	M-4
Gross Static Lift @ 62 Lbs./1000 cu.ft. at 100% inflation with 2% stretch*	39,600	40,900	40,900	40,900
Weight Empty	29,600	29,550	29,300	29,000
Useful Load*	10,000	11,400	11,600	11,900
(a) Fuel and Oil Load	7000	8400	8600	8900
(b) Crew and Service Load	3000	3000	3000	3000

* Dynamic Lift provides 3000 to 5000 lbs. additional lift and useful load.

D. POWER PLANT

Engines (2) Pratt & Whitney, Model R-1340-AN-2.
Gear Ratio 3:2 - Normal Full Rated Horsepower, 550 @ 2200 RPM.
Propellers (2) Curtiss, Series C, Model C532S, 3 Bladed, adjustable and reversible pitch, electrically controlled, hollow steel, 12 foot diameter.

E. AVERAGE PERFORMANCE

Maximum Speed, Knots	69
Maximum Horsepower	1100
Cruising Speed, Knots	50
Cruising Horsepower	430

	M-1	M-2	M-3	M-4
Fuel and Oil Consumption @ 50 Knots, Lbs./Hr.	210	212	212	212
Endurance @ 50 Knots	33.3	39.6	40.6	42.0
Range in Still Air @ 50 Knots-Nautical Miles	1665	1980	2030	2100

F. STRENGTH AND FACTORS OF SAFETY

Detailed stress analyses for the airship are given in the following reports:

Envelope Fabrics	Sq. 141
Internal Suspension	Sq. 153
Bow Stiffening and Mooring	Sq. 216, Sq. 225
Fixed and Moveable Surfaces	Sq. 177, Sq. 256, Sq. 257, Sq. 258, Sq. 259.
Car Structure	Sq. 92
Outriggers	Sq. 91

The margins of safety of the various component parts of the airship, as actually constructed, are not less than those specified below. The margin of

NOMENCLATURE FOR
HULL - GENERAL ARRANGEMENT - FIG. I

ITEM NO.	DESCRIPTION
1.	Envelope,
2.	Ballonet - Forward Assembly
3.	Ballonet - Center Assembly
4.	Ballonet - Aft Assembly
5.	Installation - Catenary - Inside Susp.
6.	Rip Panel Bonding
7.	Installation - Outside Suspension
8.	" - Rail Loop
9.	" - Car Fairing
10.	" - Conduit for Bonding and Lighting
11.	" - Fin Accessories
12.	" - Handling Lines
13.	" - Rip Panels
14.	" - Pressure Tube Access.
15.	" - Pressure Tubes
16.	" - Control Lines
17.	" - Superheat Thermometer
18.	" - Nose Stiffening
19.	" - Control Cable Guide
20.	" - Inside Suspension
21.	Designation - U.S.Navy
22.	Class Letter and Number
23.	Reinforced 20" Diameter Valve
24.	Sleeve - Inflation - 8" Diameter
25.	Manufacturer's Marking
26.	Insignia - Star
27.	Insignia - Star
28.	Installation - Access. - Inside Envel.
29.	" " - Outside Envel.
30.	Plumb Bob and Pennant Patch
31.	Patch - 8" Diameter
32.	Patch for Flag - Double
33.	Fin Suspension and Installation
34.	Remote Reading Compass Indicator
35.	M.A.D. External Install. - Ref. Only
36.	Patch Location for Nose Stiffening
37.	Airline Assembly - Forward Ballonet
38.	Airline Assembly - Aft Ballonet
39.	Assembly Blower Connector - Forward and Aft Ballonet
40.	20" Diameter Valve Assembly - Gas
41.	Installation - Car Fairing - Lacing Strip
42.	20" Valve Control Lines
43.	Shipping Box
44.	Bonding and Lighting
45.	Car

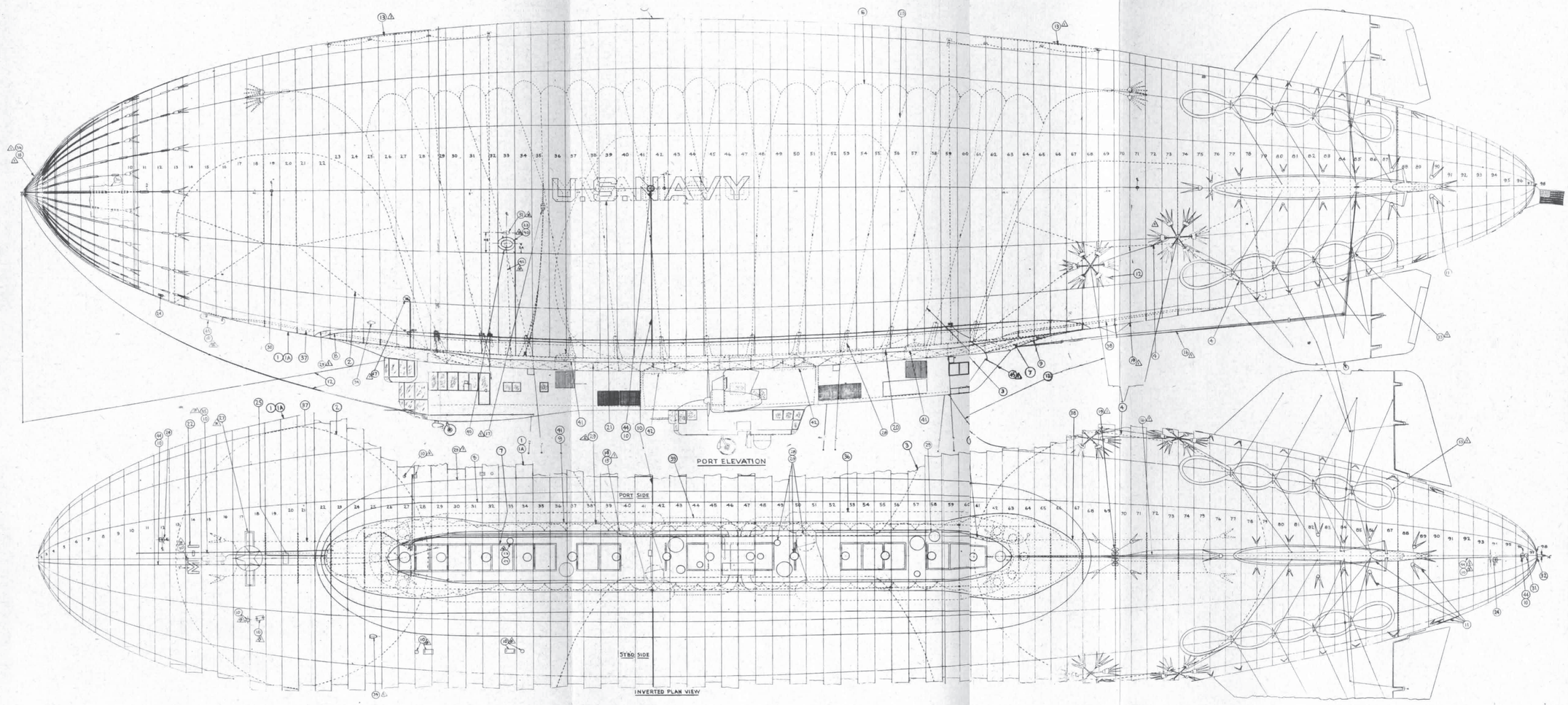


FIG. 1 - HULL - GENERAL ARRANGEMENT
(DRAWING 6092-2)

safety of any part or member is defined as the ultimate load divided by the design load, minus one. The factors are calculated for the following conditions:

Condition 1: Airship loaded for static equilibrium and level longitudinal trim with full engine power and a gas pressure of 2.00" of water at the manometer in the car.

Condition 2: Same as condition 1, but with the ship pitched up 30°.

Condition 3: Same as condition 1, but without power and the car pitched down 30°.

Condition 4: Same as condition 1, but the ship rolled 15° either side, without lateral acceleration (applicable to the car only).

Condition 5: Ship landing on the main landing wheel with a 7,500 lb. vertical reaction combined with a 2,000 lb. horizontal reaction in any direction.

Condition 6: Ship landing on the forward landing wheel with a 2,000 lb. vertical reaction combined with a 500 lb. horizontal reaction in any direction.

Condition 7: Ship moored by the bow mooring assembly with an axial force of 2000 lb. tension or 5000 lbs. compression combined with a transverse force of 5500 lbs. and a vertical lifting force of 3000 lbs.

Condition 8: Ship moored by the bow mooring assembly with an axial force of 3,500 lbs. tension or 1500 lbs. compression combined with a transverse force of 10,000 lbs.

Condition 9: Ship moored by the bow mooring assembly with an axial force of 6,000 lbs. tension with no transverse forces.

Condition 10: The horizontal fins are designed for a mean aerodynamic load of 7 lbs./sq.ft. and the elevators for a mean aerodynamic load of 8 lbs./sq.ft. The vertical fins are designed for a mean aerodynamic load of 8 lbs./sq.ft. and for 9½ lbs./sq.ft. on the rudders.

Condition 11: All fins and control surfaces simultaneously carrying 70% of the loads of condition 10.

Condition 12: Bending and shear, resulting from an aerodynamic bending moment curve subject to the approval of the bureau, acting in a sagging condition, combined with loads and gas pressure of condition 1. (Envelope only).

Condition 13: Same as condition 12, but the bending acting in a hogging direction and with all disposable loads discharged. (Envelope only).

Condition 14: Same as condition 1, but with reverse propeller thrust.

Condition 15: Same as condition 1, but with propeller thrust either forward or reverse on one side only.

Condition 16: Same as condition 1, but with all disposable loads discharged and a drag rope or towing load of 2000 lbs. at the drag rope connection.

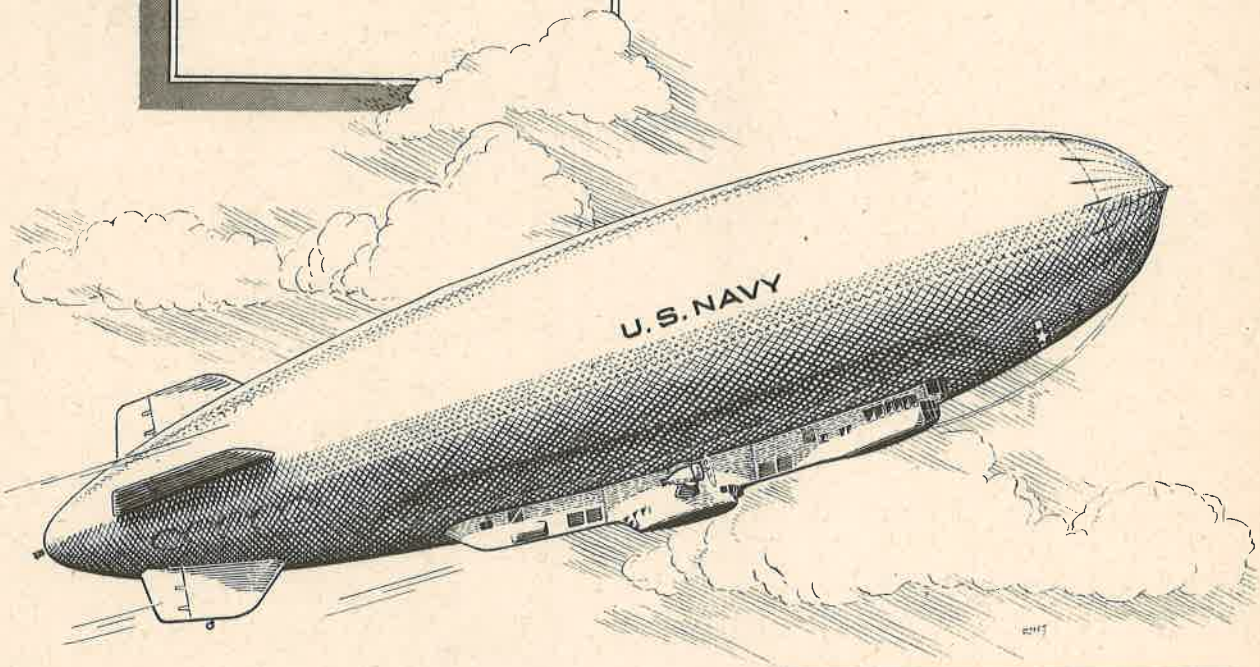
The minimum *margins of safety of the various parts of the airship under these conditions are:

ITEM	Condition	MARGIN OF SAFETY
Envelope Fabric	1, 2, 3	4
Envelope Fabric	12, 13	3
Car Suspension	1, 2, 3, 14, 15, 16	3
Bow Stiffening	1, 2, 7, 8, 9	1
Bow Mooring Assembly	7, 8, 9	1
Car Structure	1, 2, 3, 4, 5, 6, 14, 15, 16	2
Engine Mounts and Outriggers	1, 2, 3, 4, 5, 6, 16	5
Engine Mounts and Outriggers	14, 15	4
Landing Gear and Supporting Structure	5, 6	3
Fins and Control Surfaces	10, 11	2
Fin Suspension	10, 11	2
Surface Controls	10, 11	3

* Margin of Safety (as defined in standard airship practice) is equal to the ultimate allowable load divided by the expected design load minus one.

Part II

The Envelope



Goodyear "M" Airship

- THE ENVELOPE -

A. GENERAL ARRANGEMENT

The general arrangement of the airship envelope, together with accessories, is given on the following GAC drawings:

M-1	Drawing 6092-2 (Fig. 1)
M-2	Drawing 6092-602
M-3 & M-4	Drawing 6092-802

The theoretical shape of the envelope is that of a solid of revolution, the contour of which conforms to the following equation:

$$Y = R\left[1 - \left(\frac{X}{a} - 0.2\right)^2\right]^{0.5} \left(1.02062 - 0.21263\ \frac{X}{a}\right)$$

Where: Y = the radius at any station

R = the maximum radius

X = distance of any station from the maximum section, exclusive of parallel middle body.*

a = theoretical envelope length, less parallel middle body* divided by two.

The envelope is divided circumferentially into sixteen equal gores and longitudinally into ninety eight** panels, plus patterns or caps on the forward and after ends. The direction of the fabric bias is alternated in each ring panel, the warp of the straight plies extends circumferentially around the envelope.

* Parallel middle body in airships M-2, M-3 and M-4 only, totals six feet four inches in longitudinal length.

** M-2, M-3 and M-4 have two additional panels added at the maximum section between panels 41 and 42.

B. FABRICS (M-1 and M-2)

The type and arrangement of fabrics used in the envelope proper is shown on the following GAC drawings:

Title	Drawing No.	
	M-1	M-2, M-3 & M-4
Fabric Distribution	6092-4	6092-604
Fabric Specifications	SK-6-7240	SK-6-7240
Typical Seams, Envelope & Ballonet	640-1500	640-1500
Special Fabric Laps at Gore Seams F-G & J-K	6092-11	6092-11

- THE ENVELOPE -

The construction of the various fabrics is as follows:

Envelope Fabrics

	(Gas Tight)	(Air Tight)	(Car Cover)	(Bow & Stern)	(M 3 & 4)
GAC Code No.	Q13A23	Q13A24	Q13A25	Q13A30	Q13A31
Wt. oz/sq.yd.					
Aluminum	.8	.8	--	.8	1.2
Rubber	1.0	1.0	1.0	.9	1.0
Cloth, Str.	2.9	2.9	2.9	2.9	2.9
Rubber	3.9	2.9	2.9	3.0	3.9
Cloth, Bias	5.0	5.0	5.0	2.9	5.0
Rubber	3.1	2.9	3.0	2.5	3.1
Cloth, Str.	5.0	5.0	2.9	2.9	5.0
Rubber	1.1	1.1	1.1	.5	1.1
Nominal Weight	22.8	21.6	18.8	16.4	23.2
Tolerance Plus or Minus	.5	.5	.5	.5	.5
*Minimum Tensile Warp in lbs/in.	275	275	200	160	275
*Minimum Tensile Fill in lbs/in.	240	240	170	140	240
Max. Permeability in Liters of Hydrogen per square meter per 24 hours at 25°C & 760 MM. Hg.	12	20	15	12	12

*Cylinder burst method.

Ballonet Fabric

	GAC Code No.	Q28A9
Wt. oz/sq.yd.	Rubber	0.5
	Cloth, Str.	2.0
	Rubber	4.0
	Cloth, Str.	2.0
	Rubber	0.5
	Nominal Weight	9.0
	Tolerance, Plus or Minus	.5

**Min. Tensile Strength Warp, lbs/in. 75

**Min. Tensile Strength Fill, lbs/in. 65

Max. Permeability in Liters of Hydrogen per square meter per 24 hours at 25°C and 760 MM. Hg. 15

**2" Strip Method

Catenary Fabrics

	Inside	Outside
GAC Code No.	Q65A6	Q13A28
Wt. oz/sq.yd.		
Aluminum	-	0.8
Rubber	0.5	1.0
Cloth, Str.	2.9	2.9
Rubber	2.7	2.4
Cloth, Str.	2.9	5.0
Rubber	0.5	2.5
Cloth, Str.	-	2.9
Rubber	-	1.1
Nominal Weight	9.5	18.6
Tolerance, Plus or Minus	0.5	0.5
*Min. Tensile Strength Warp, lbs/in.	110	200
*Min. Tensile Strength Fill, lbs/in.	100	170

Permeability - No requirements

*2" Strip Method

Rip Panel Fabric

GAC Code No.	Q68A4
Wt. oz/sq.yd.	
Rubber	1.0
Cloth, Str.	4.2
Rubber	2.6
Cloth, Str.	4.2
Rubber	4.6
Cloth, Str.	4.2
Rubber	0.5
Nominal Weight	21.3
Tolerance, Plus or Minus	.5
*Min. Tensile Strength Warp, lbs/in.	225
*Min. Tensile Strength Fill, lbs/in.	225
Max. Permeability in Liters of Hydrogen per square meter per 24 hrs. at 25°C & 760 MM.Hg.	15

*2" Strip Method

Tape

	Air Side	Gas Side
GAC Code No.	Q-52	Q-54
Wt. oz/sq.yd.		
Aluminum	.8	-
Rubber	.9	1.0
Cloth, Bias	2.0	2.0
Rubber	3.5	3.5
Nominal Weight	7.2	6.5
Tolerance, Plus or Minus	.5	.5

Tensile Strength - No Requirements

Permeability - No Requirements

Patch Fabric

	Aluminized	Plain
GAC Code No.	Q36A	Q60A1
Wt. oz/sq. yd.		
Aluminum	.8	-
Rubber	.9	.7
Cloth, Str.	4.2	4.2
Rubber	.5	.7
Nominal Weight	6.4	5.6
Tolerance, Plus or Minus	.5	.5
*Min. Tensile Strength Warp, lbs/in.	80	80
*Min. Tensile Strength Fill, lbs/in.	80	80

Permeability - No Requirements

*2" Strip Method.

Car Fairing Fabric

GAC Code No.	Q37A1
Wt. oz/sq. yd.	
Rubber	0.3
Cloth, Str.	2.9
Rubber	3.1
Nominal Weight	6.3
Tolerance, Plus or Minus	.5

*Min. Tensile Strength Fill, lbs/in. 55

*Min. Tensile Strength Warp, lbs/in. 55

Permeability - No Requirements

*2" Strip Method

C. CEMENTS, RUBBER PAINTS, ACCELERATORS AND SOLVENTS

(Manufactured by Goodyear Tire and Rubber Company)

Listed below are the cements, rubber paints, accelerators and solvents used in the construction of the envelope and accessories:

Code No.	Type	Recommended Use
Cements:		
200-C	B	Rope Impregnating (Patches)
219-C*	B	Rope Impregnating (Patches)
221-C*	B	Plug or Dough Cement (Patches)
5613-C	A	Seam Cement
Paints:		
5602-C	A	Red Insignia
5603-C	A	White Insignia
5604-C	A	Blue Insignia
5606-C	A	Aluminum Paint
Accelerators:		
990-C	-	(Used with 5613-C Cement)
Solvent:		
42-431	-	Thinner or Solvent for all rubber type B Cements.

NOTE: Types A are self-curing cements.
Types B are air-drying cements.

*Acid neutralizing and mildew inhibiting cements as used on top half of envelopes D-352, D-353; and total exposed surface of D-354.

D. PROOFING

The entire inner surface of the envelope (coming in contact with the gas and air) is coated with paraffin not to exceed 0.5 oz./sq.yd. The air and gas sides of all ballonet diaphragms are coated with paraffin not to exceed 0.5 oz./sq. yd.

E. SEAMS

The longitudinal and circumferential envelope seams for the gas-tight fabric are of 1-inch lap, cemented, double sewed, and covered on the inside and outside with tape. The seam covering on the outside of the envelope is of a single piece of 1-5/8 inch wide tape, while that on the inner surface is a double tape 1-5/8 inch and 2-3/8 inch wide.

The longitudinal and circumferential envelope seams for the air-tight fabric are 1-inch lap, cemented, double sewed, and covered on both inside and outside with single tape 1-5/8 inch wide.

The ballonet seams are 1/2-inch lap, cemented, but not sewed, with single tape 1-1/8-inch wide, both inside and outside.

F. INSIDE SUSPENSION SYSTEM

The inside suspension system of the car consists of a system of cables attached at one end to fittings on the car framework and at the other end to the inside catenary curtain concentration points.

1. Inside Catenary Curtains

Two catenary curtains are located near the top of the envelope for attachment of the inside suspension system. These curtains are located symmetrically 45° from the top of the envelope at the seams of gores J-K and G-F. Including the anchor patches, they extend from panel 17 to panel 72 (Panel 18 to panel 71 for M-2, M-3 and M-4). The two catenary curtains support approximately 50% of the control car load.

Each curtain has 24 concentration points for the attachment of the suspension cables. An aluminum alloy ring with a steel insert is securely lashed into the curtain at each of the two end concentration points. At all points between these two end points of the curtain the cable forms a loop over a standard thimble and is held in place by a Nicopress fitting.

The lower edges of the curtains are reinforced with 5/32-inch diameter (7 x 19) steel cables through the first concentration point on each end of the catenary, with a 1/8-inch diameter (7 x 19) steel cable as intermediary reinforcement through all other concentration points (Dwg. 5092-11 for M-1; Dwg. 5092-612 for M-2, M-3 and M-4). Each curtain reinforcement cable is bridled out at each end of the curtain and attached to the envelope by means of two four finger patches, with turnbuckles installed for adjustment.

2. Inside Suspension Cables

The suspension cables from each curtain lie in a plane making an angle of 35° with the vertical. The cables from the catenary curtain concentration points meet at a point somewhat below the equator and each pair connects into one vertical cable which attaches to the car structure. Thirteen such vertical cables attach to the car. Except for the extreme forward and after cables, each vertical cable is bifurcated longitudinally above the point where the cables from the two curtains meet. (Dwg. 6092-12) Fig. III.

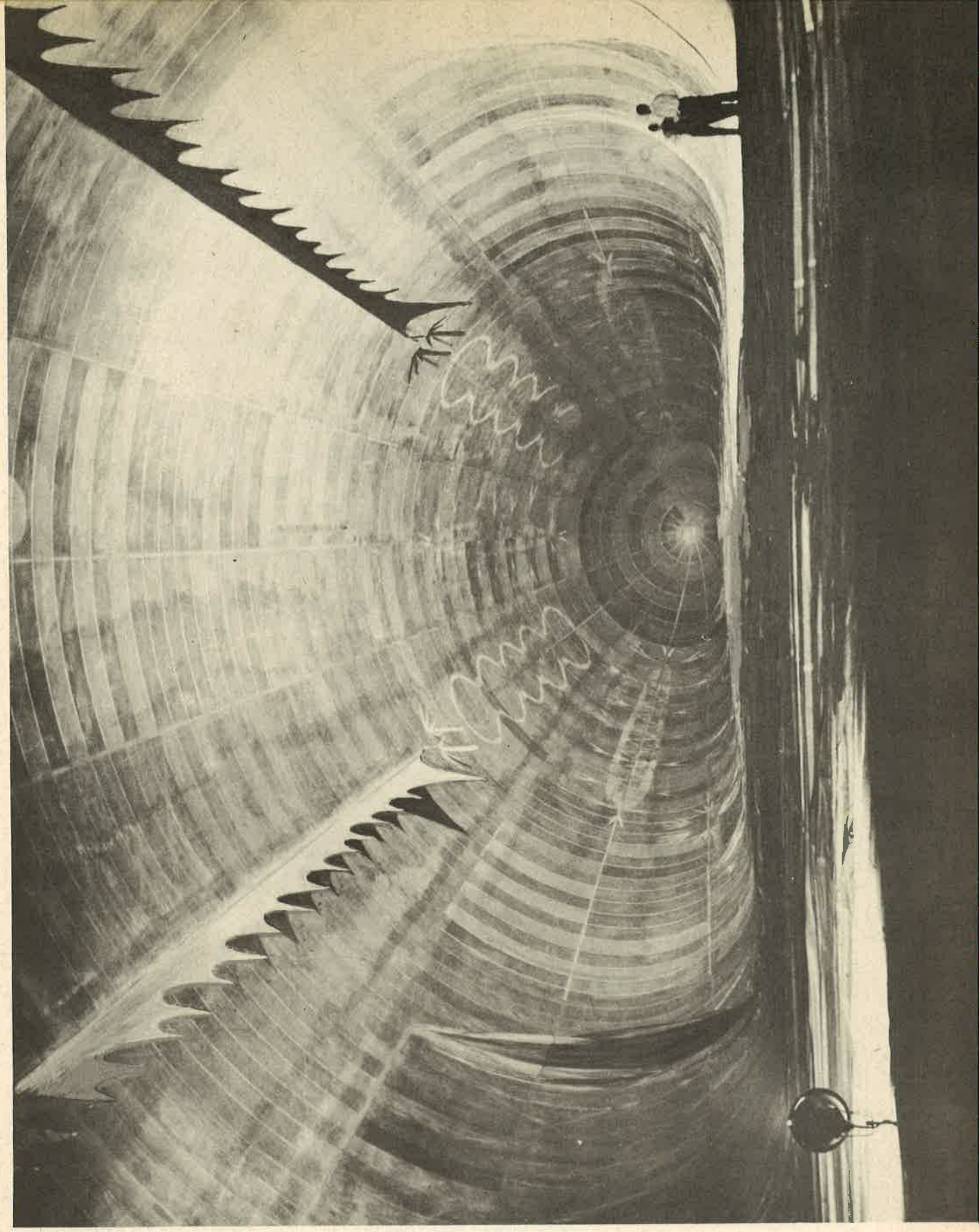


FIG. 11 - VIEW OF INSIDE SUSPENSION CURTAINS

The suspension cables range in size from 1/8-inch to 11/32-inch in diameter (7 x 19) and are of carbon steel per Spec. AN-RR-C-43. They are protected from corrosion by two coats of spar varnish, the final coat being tinted with Prussian Blue.

All closed loops on the cables are made around split thimbles and secured with Nicopress fittings.

The suspension cables are attached to the bushings or thimbles of the catenary curtain by means of shackles.

Shackle and link fittings provide universal connections between the cables and the thirteen suspension points on the car. A special turnbuckle with an extra long takeup is installed in each cable at the top of the car for tension adjustment of the cables. Fabric sleeves extending into the gas space and enclosing the turnbuckles are provided for each cable with gas-tight gland fittings where the cables enter the gas compartment. A sufficient length of cable is housed in each of these sleeves to permit tension readings to be taken with a tensiometer.

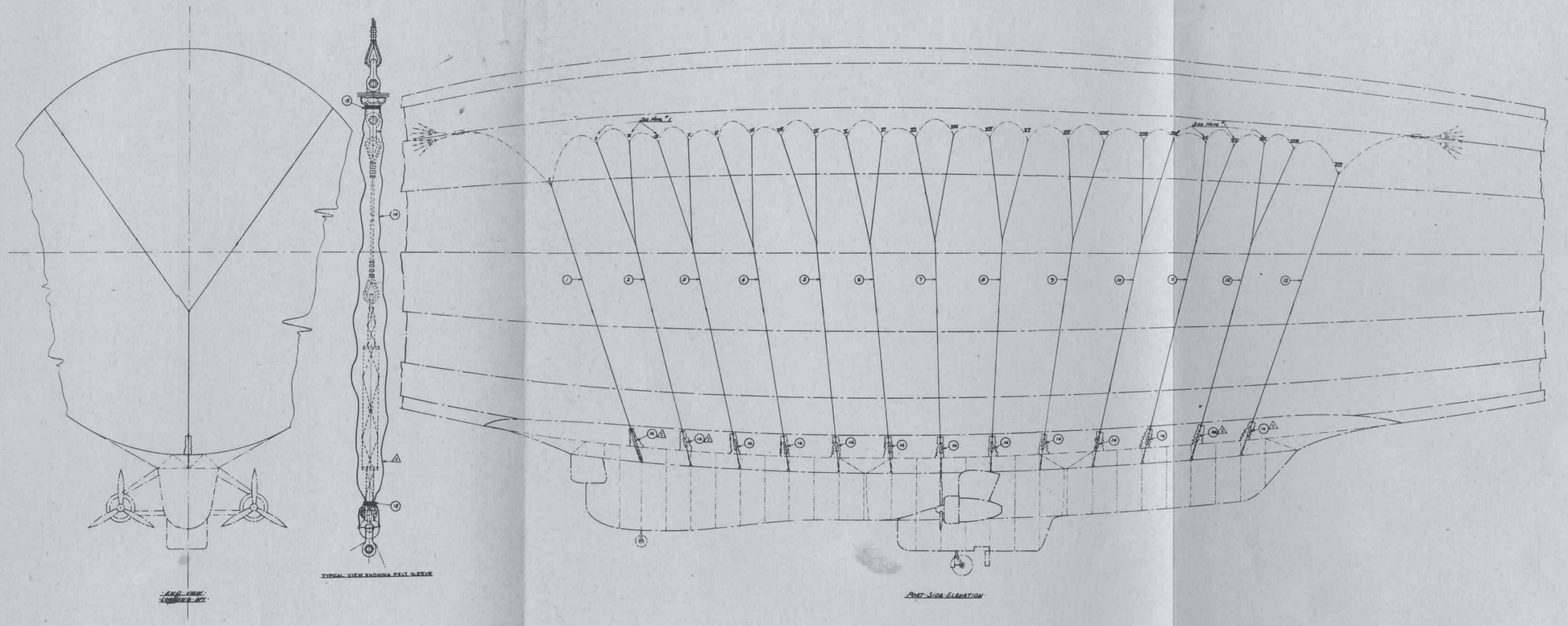
G. OUTSIDE SUSPENSION SYSTEM

The outside suspension system (Dwg. 6092-14 for M-1; 6092-614 for M-2 and Future) consists of flexible steel cables connecting the sixty-four concentration points of the outside catenary curtain with the fifty-eight suspension points on the car structure. These cables carry approximately 50% of the vertical control car load and take the major part of the horizontal fore-and-aft loads when the ship is pitched up or down. They also carry the transverse loads when the ship has an angle of roll.

Sixteen No. 10 patches (fourteen for M-1 and M-2) on each side of the car at varied spacings, cemented to the envelope and attached to the upper car longeron by Cord-O-Hyde lacing, prevent lateral movement of the otherwise unrestrained fabric above the car (Dwg. 6092-32 for M-1; 6092-632 for M-2, M-3 and M-4). Chafing strips of Q13A30 fabric are installed on the envelope and airline surfaces wherever abrasion might occur.

1. Outside Catenary Curtain

The top of the car is attached to the bottom of the envelope by means of a continuous fabric curtain extending longitudinally from panel 22 to panel 68 (Panel 22 to panel 67 for M-2, M-3 and M-4). The curtain is tangential to the envelope at its junction point. The inner edge of this curtain is scalloped into catenary curves which intersect to provide 64 concentration points



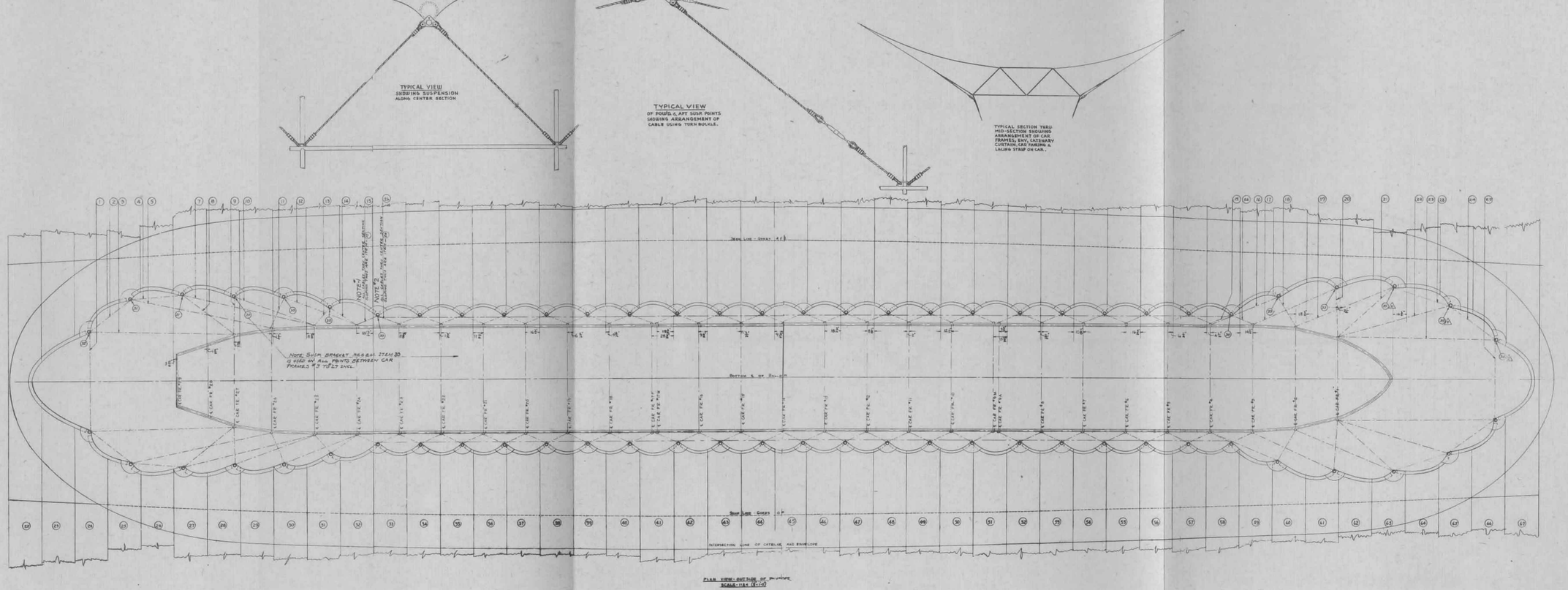
NOMENCLATURE

Items 1 thru 13 - Inside Suspension Cable Units "A" thru "M"

Item 14 - Suspension Cable Sleeve

Item 15 - Lashing Cord No. 6

FIG. III - INSIDE SUSPENSION ASSEMBLY
(DRAWING 6092-12)



NOMENCLATURE

NOs. 1 to 28 - Cable Assembly
NOs. 30 to 35 - Suspension Bracket Assembly
Other NOs. - Panel Designation

FIG. IV - OUTSIDE SUSPENSION
(DRAWING 6092-14)

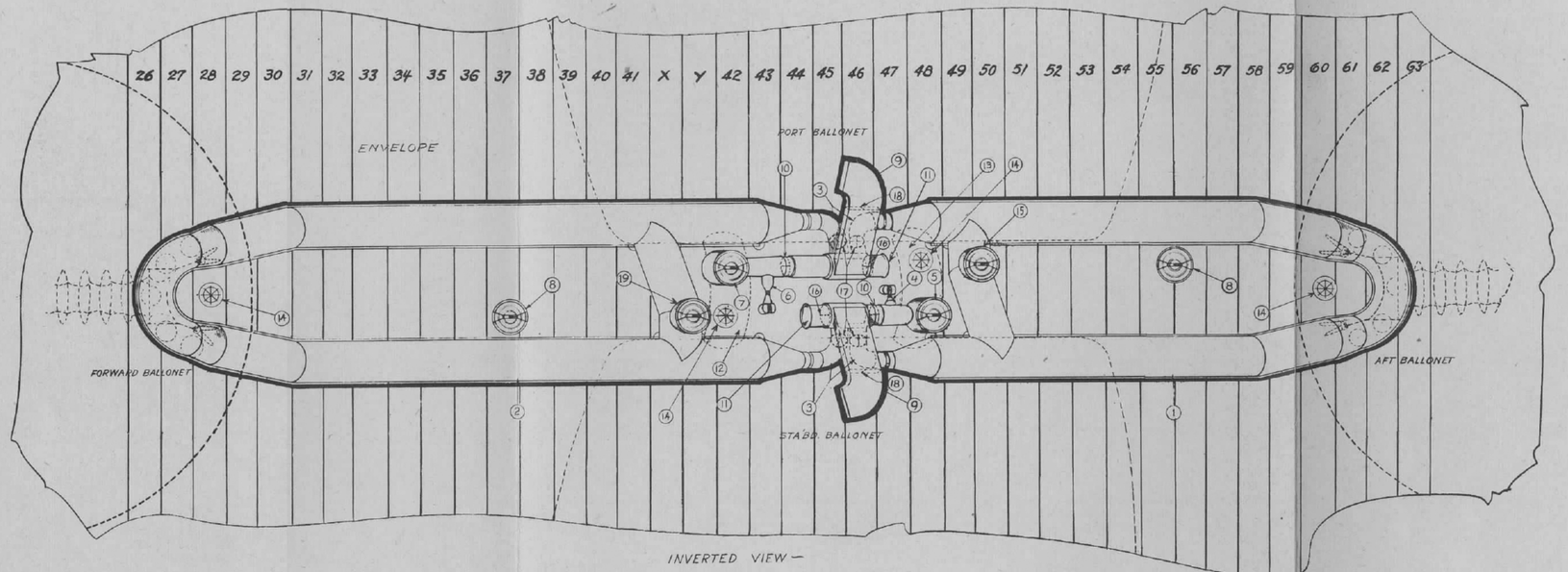


FIG. V - AIR PRESSURE SYSTEM
(REF. DRAWING 6092-616)

NOMENCLATURE

1. Aft Long Air Line
2. Forward Long Air Line
3. Blower Connections
4. Sleeve - Air to Helium - Aft
5. Sleeve - Aft Air Valves - Center Ballonet
6. Sleeve - Air to Helium - Forward
7. Sleeve - Forward Air Valve - Center Ballonet
8. Sleeve - Gas Valve
9. Air Scoops
10. 24-inch Damper Valve
11. Blower Unit
12. Tunnel-Port & Starboard Ballonets - Forward
13. Tunnel-Port & Starboard Ballonets - Aft
14. Manholes
15. Air Valve in Aft Cross-over Sleeve
16. Check Valve
17. 19-inch Damper Valves
18. Check Valves
19. Air Valve in Forward Cross-over Sleeve

for attachment of the outside suspension cables (Dwg. 6092-13 for M-1; Dwg. 6092-613 for M-2, M-3 and M-4). Each concentration point of the outside catenary curtain has an aluminum alloy ring securely lashed into the curtain. Each ring has a steel insert to act as a bushing for the suspension cables. The edges of the scallops are reinforced with 3/16-inch, 7/32-inch, or 1/4-inch diameter (7 x 19) carbon steel cables which also help in securing the rings at the concentration points.

2. Outside Suspension Cables

The outside catenary cables are constructed of carbon steel per spec. AN-RR-C-43 (7 x 19) and range in size from 5/32-inch to 1/4-inch diameter. All cable ends are looped around split thimbles and secured with Nicopress fittings. Turnbuckles are installed in the twenty-six major cables (Dwg. 2092-78) for tension adjustment; the balance of the cables (Dwg. 2092-79) are permanently secured at erection. A single coat of Par-al-ketone is applied for protection from corrosion.

H. AIR SYSTEM

The air system consists of four ballonets, two outrigger air scoops, two auxiliary blowers, two overhead air manifolds, two complete ballonet airline systems, four air discharge valves, six damper valves, four check valves, two air-to-helium emergency sleeves, four manholes with appendix sleeves for access to airlines and ballonets, and all necessary instruments and controls for operation of the system.

I. Ballonets

The four ballonets (Dwg. 4092-6, -8, -10 for M-1; 4092-606, -608, -610 for M-2, M-3 and M-4) are located as follows:

One forward, one aft, and two symmetrically located about amidship on either side of the longitudinal centerline. The two center ballonets are interconnected by two transverse ducts and therefore act as a unit.

All ballonets have connecting airlines and valves for controlling the pressure within the envelope. Flow of air into and out of the ballonets is through fabric airlines running along the bottom of the envelope exterior. (See Fig. IX). A hood supported by aluminum alloy hoops is provided inside both the forward and after ballonets extending from the ballonet airline ports well into the ballonet, thus preventing a partially deflated ballonet from closing off the airline and trapping air in the

ballonet. (Dwgs. 5092-61, -64 for M-1; 5092-615, -628 for M-2; 5092-828, -815 for M-3 and M-4).

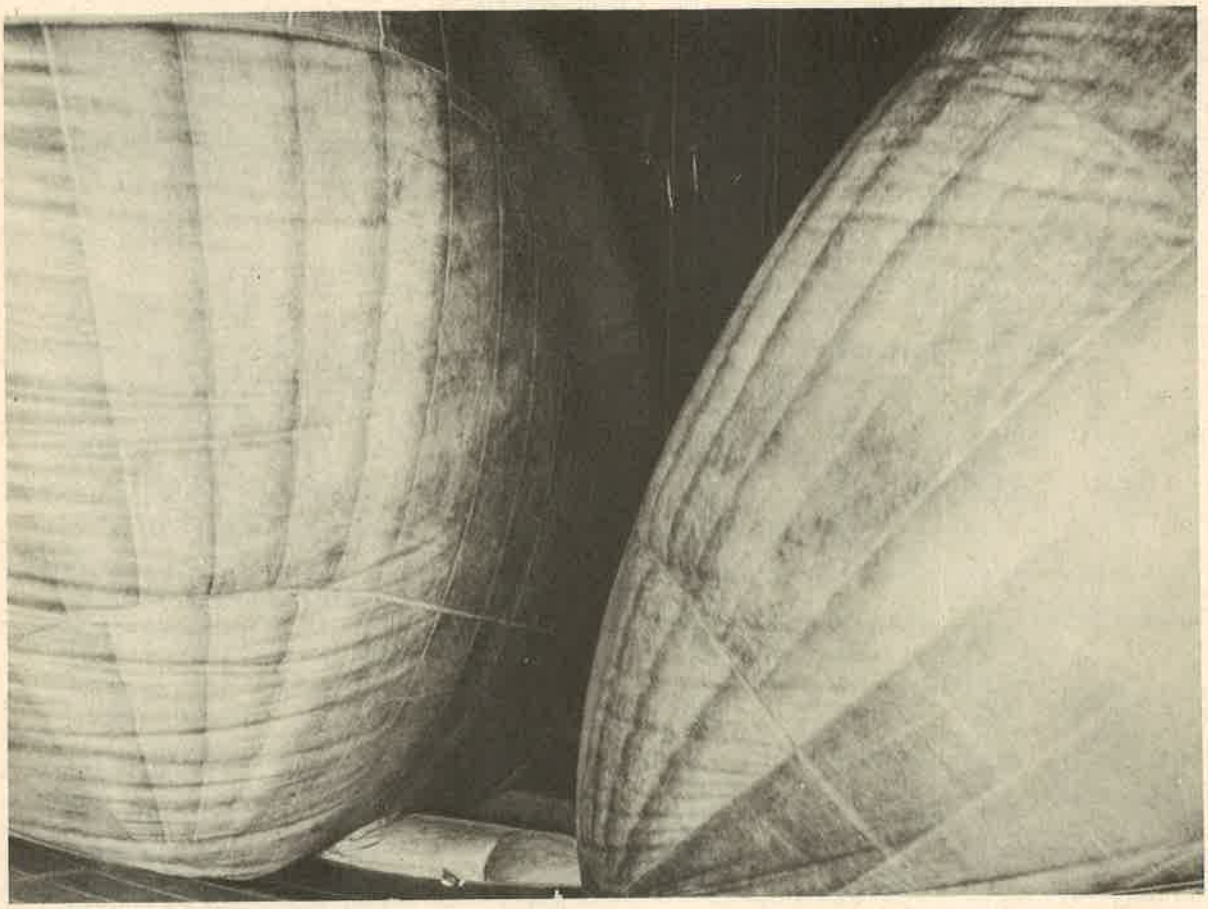


FIG. VI - VIEW OF MID BALLONETS

The ballonets are constructed of two-ply fabric as specified under "Fabrics" with seams having 1/2-inch lap. The seams are cemented and taped inside and outside, but are not sewed.

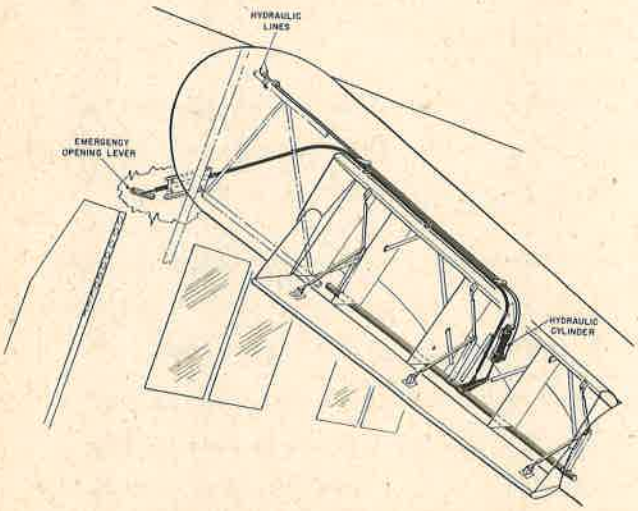


FIG. VII - OUTRIGGER AIR SCOOP

2. Air Scoops

The air scoops for the air pressure system are located in the leading edge of each upper outrigger cowling. They are airfoil shaped and open outward to permit the air to enter the cowling. (See Fig. XLI). Under normal conditions the scoops are independently operated by remote hydraulic control from the pilot's compartment. Under emergency conditions, they can also be operated manually by

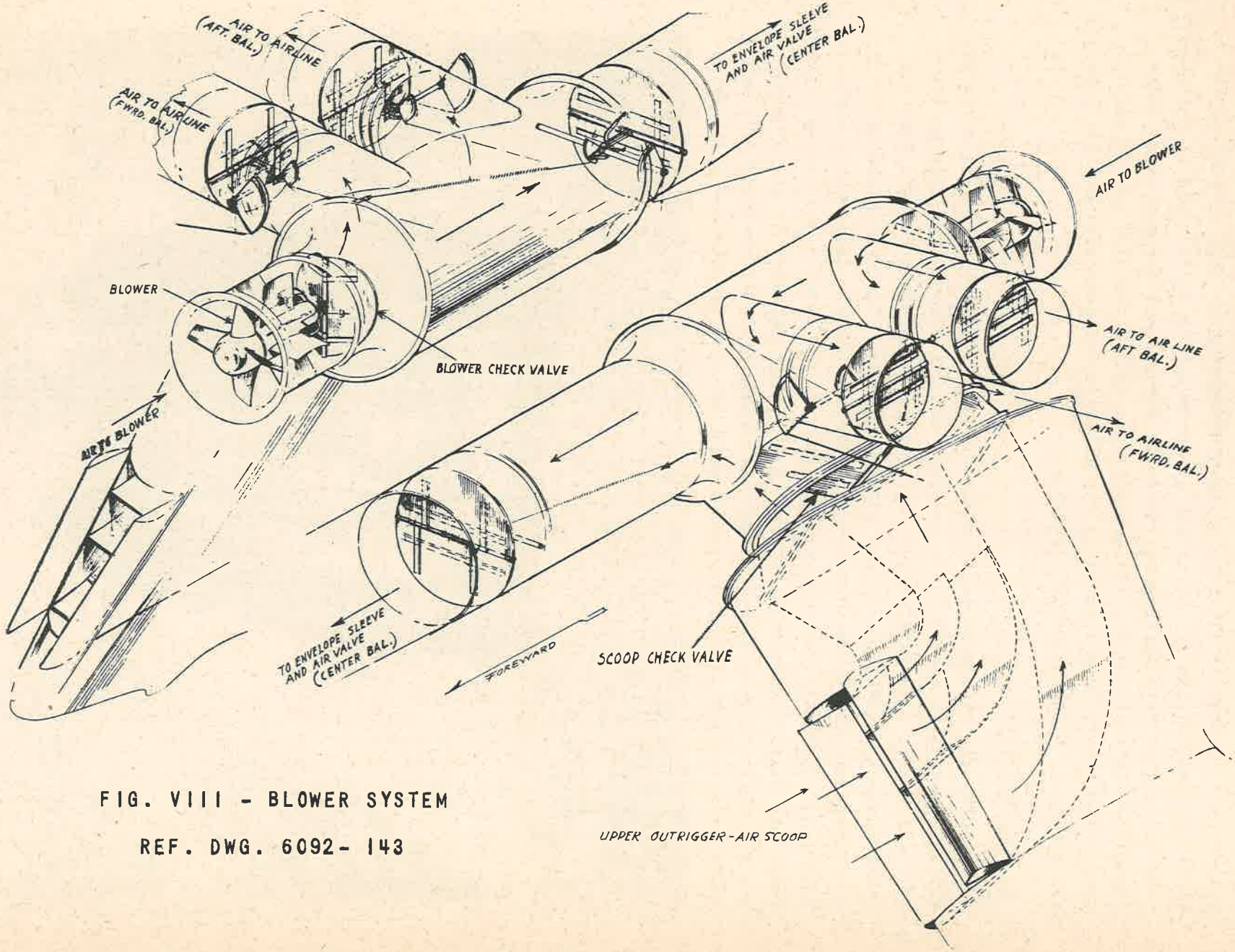

AIR TO AIR LINE (AFT. BAL.)
AIR TO AIR LINE (FWRD. BAL.)
TO ENVELOPE SLEEVE AND AIR VALVE (CENTER BAL.)
BLOWER
BLOWER CHECK VALVE
AIR TO BLOWER
AIR TO AIR LINE (AFT BAL.)
AIR TO AIRLINE (FWRD. BAL.)
AIR TO BLOWER
TO ENVELOPE SLEEVE AND AIR VALVE (CENTER BAL.)
FOREWARD
SCOOP CHECK VALVE
UPPER OUTRIGGER-AIR SCOOP

FIG. VIII - BLOWER SYSTEM

REF. DWG. 6092- 143

a lever arm located in the car, adjacent to each outrigger. Metal ducts, formed by the outrigger cowling and suitable baffle walls, conduct the air from the scoops into the air manifolds in the car. A one-way check valve, installed within the air duct just after it enters the side of the car, allows the air to flow through in the direction of the ballonets but prevents any air flow in the opposite direction.

3. Air Manifolds

Two air manifolds of aluminum alloy construction are located in the top of the mid-car structure on the port and starboard sides between frames 12 and 13 (Dwg. 6092-144). From each air manifold ducts connect with air lines running to the forward and after ballonets. The two center ballonets are interconnected by two transverse equalizer ducts. The forward equalizer duct is connected to the port air manifold on the forward side while the aft equalizer duct is connected to the starboard air manifold on the after side. The air ducts to the forward, after and center ballonets from the air manifolds are provided with valves and damper controls by means of which it is

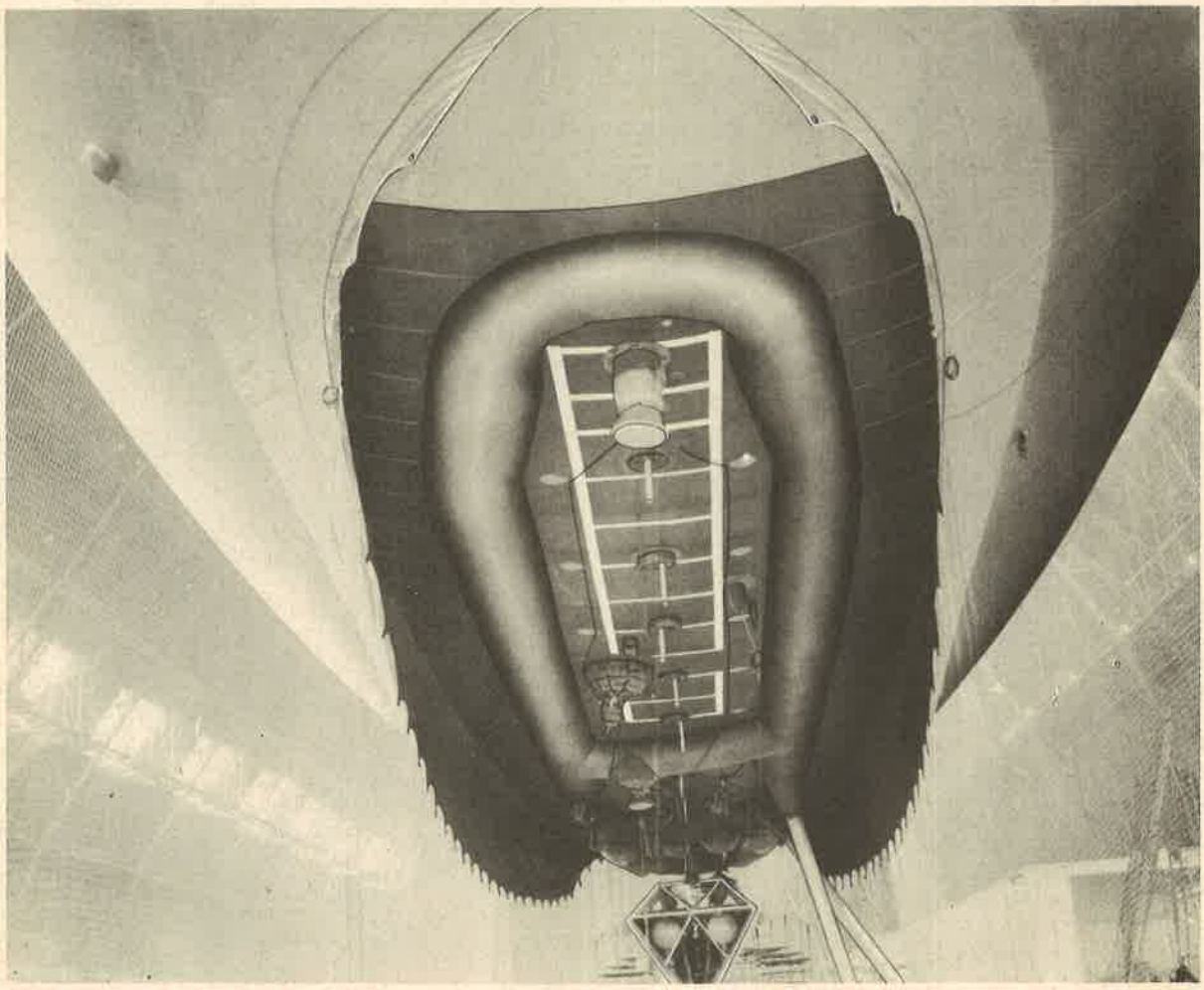


FIG. IX - VIEW OF AIR LINES AND OUTSIDE ACCESSORIES

possible to direct the air flow to the forward, after or center ballonet system from either or both the port and/or starboard scoops. Either or both, therefore, may be used to serve any part or all of the ballonet system.

4. Air Lines

Fabric air lines extend along the bottom of the envelope exterior from the port and starboard air manifolds to the forward, after, and center ballonets. (See Dwg. 6092-32 for M-1; 6092-616 for M-2; 6092-816 for M-3 and M-4.) Over most of their length the envelope forms the top wall of each air line. The port and starboard air lines are connected at their extreme

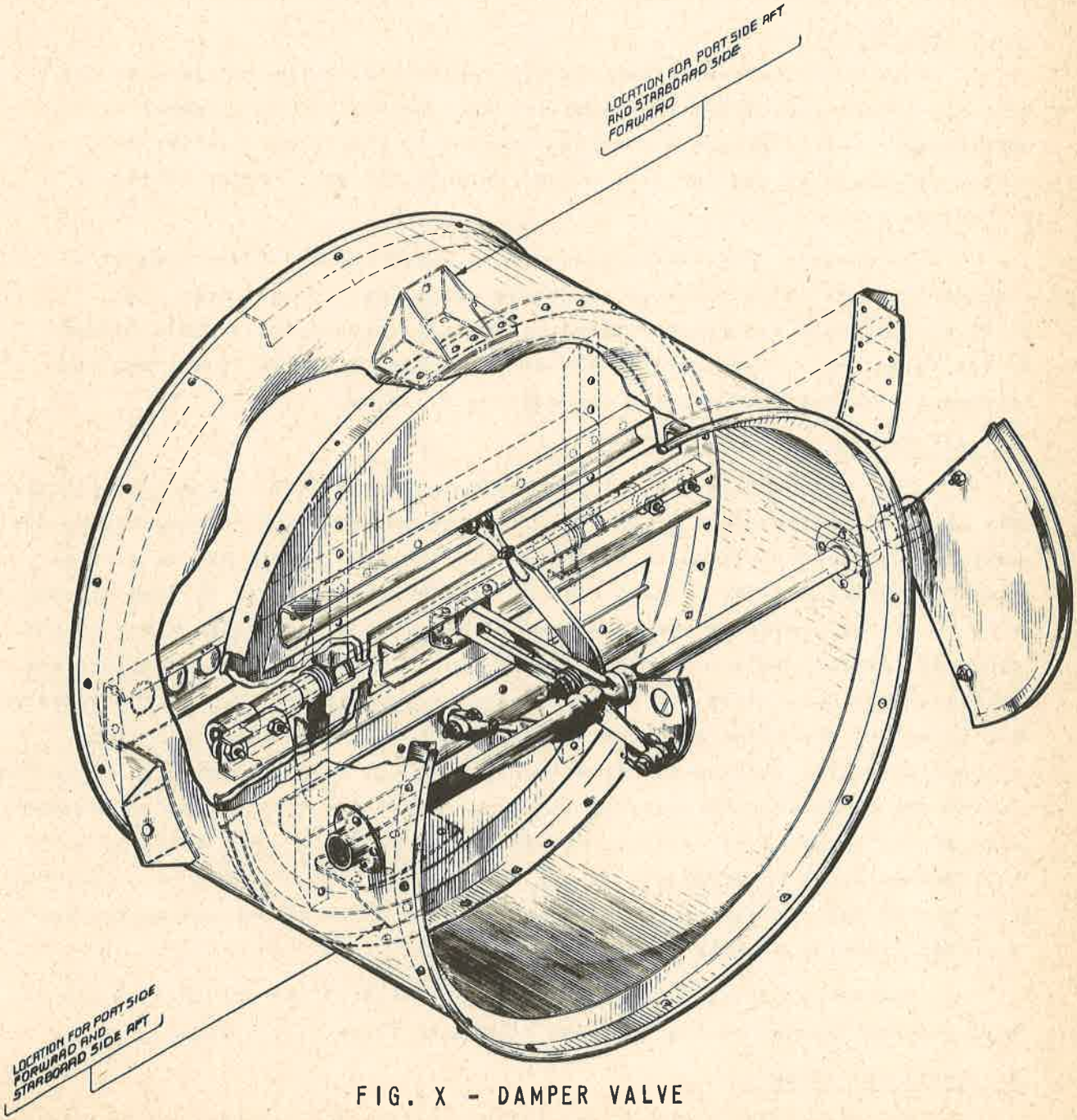


FIG. X - DAMPER VALVE

forward and after ends, making a continuous circuit. Near their midship section, each circuit is connected by a crossover duct in which is installed a 36-inch air valve. These airline circuits are connected to the outrigger air scoops and to blowers built into the ends of the manifolds. The equalizer ducts of the center ballonet system are connected to the air manifolds by means of short, circular cross section fabric airlines.

Fabric sleeves are used as connecting links in the system. These sleeves are entirely independent of the envelope and serve to provide flexible connections in the airlines to allow for any placement variation due to fabric stretch or other causes.

5. Damper Valves

The air ducts connecting the air manifold with the airlines to the forward, after, and center ballonets are each provided with a damper valve. These damper valves permit air to be directed to the forward, after or center ballonets as desired from either or both the port and/or starboard air manifolds.

The dampers (Dwg. 4092-124-1 and -2, 6092-135 and -136) consist of a butterfly type valve operated by remote mechanical control from the pilot's instrument and control panel. The valves are normally held closed by spring action. These springs are so positioned that the force required to open the valves decreases as the opening increases.

6. Air Valves

Four 36-inch diameter air valves are provided for discharging air from the ballonet system (Dwg. 6080-1262). Two of these valves are located in the bottom of the equalizer ducts of the center ballonet system for valving air from the center ballonets (port side of car at panels 42 and 43, and starboard side of car at panels 49 and 50, respectively, for M-1; panels Y and 42 and panel 48, respectively, for M-2, M-3 and M-4). The other two air valves are located in the bottom of the forward transverse connector duct of the forward air lines and the after transverse connector duct of the after air lines, respectively, for valving air from the forward and after ballonets. These two valves are equipped with dashpots to prevent possible chattering, (starboard side of car at panels 41 and 42, and port side of car at panels 50 and 51 for M-1; panels X and Y and panels 49 and 50, respectively, for M-2, M-3 and M-4). All four of the air valves are automatic in operation but may be mechanically operated from the pilot's control panel.

The air discharged from the valves exits from the car through bronze vent screens located on the port and starboard sides of the car.

7. Auxiliary Blowers

Two electrically driven axial flow blowers manufactured by the LaDel

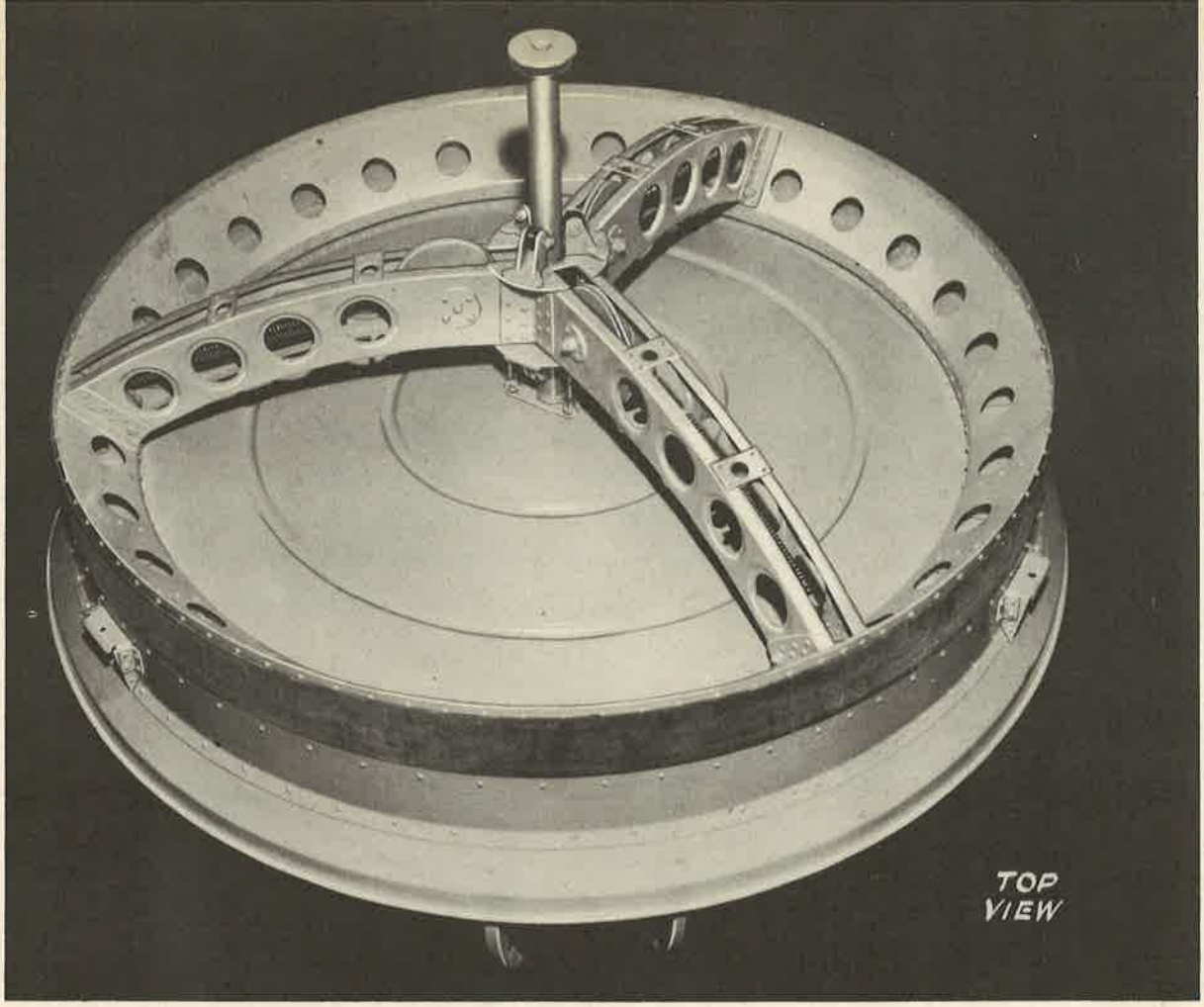
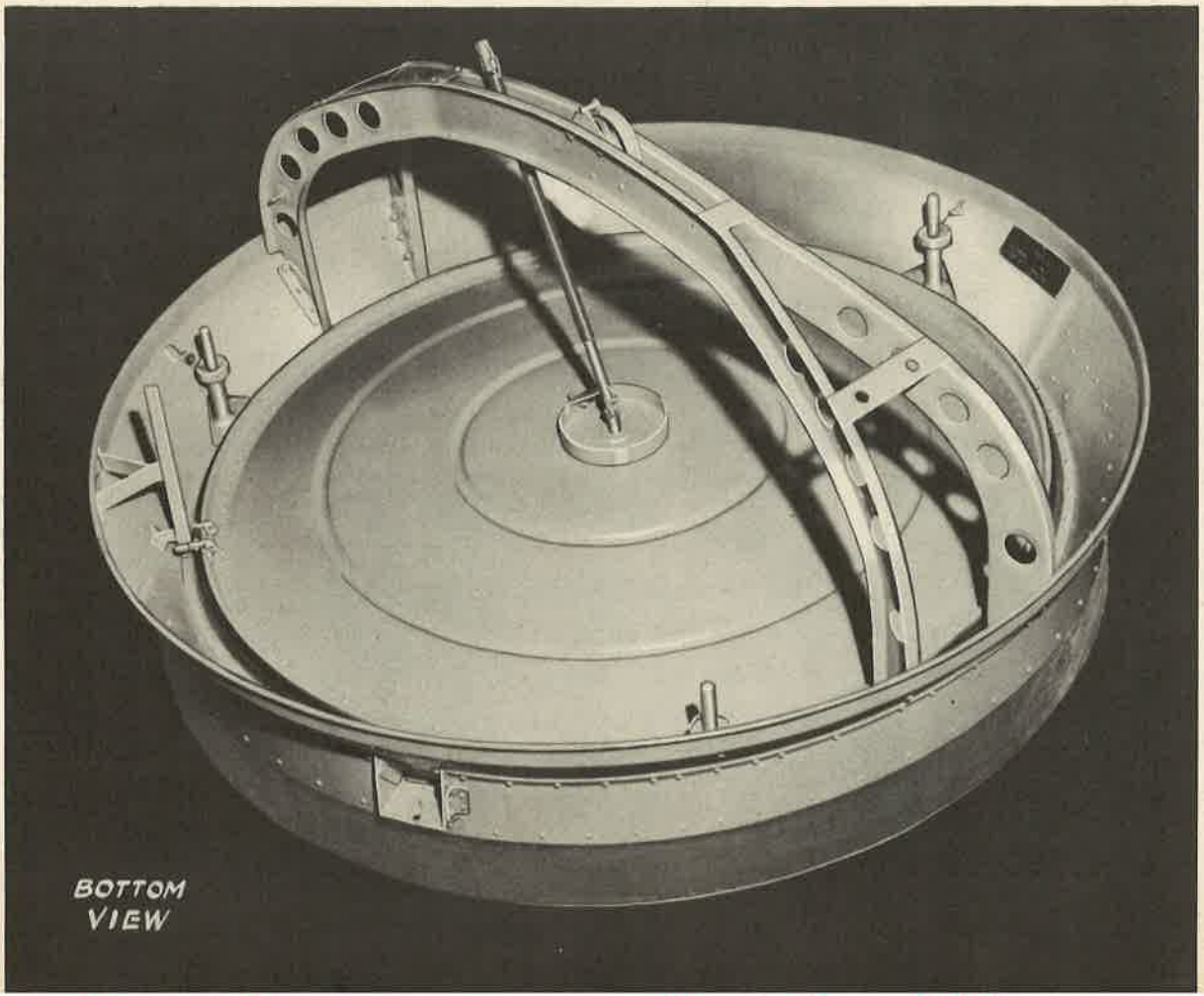


FIG. XI - AIR OR GAS VALVE (36-INCH)



Conveyer & Mfg. Company, are installed on the port side aft of frame 12, and the starboard side forward of frame 13, in the upper structure of the car. (Dwg. 4092-229). The port blower faces aft and the starboard blower faces forward. The blower control switches are located on the lower port side of the pilot's instrument panel.

The port and starboard blowers are connected to the port and starboard air manifolds respectively. A butterfly type check valve which is located between each manifold and blower, opens under air pressure from the blower, but closes to prevent air escapement when the blower is not in operation. The blower check valve is normally held in a closed position by an axial type spring.

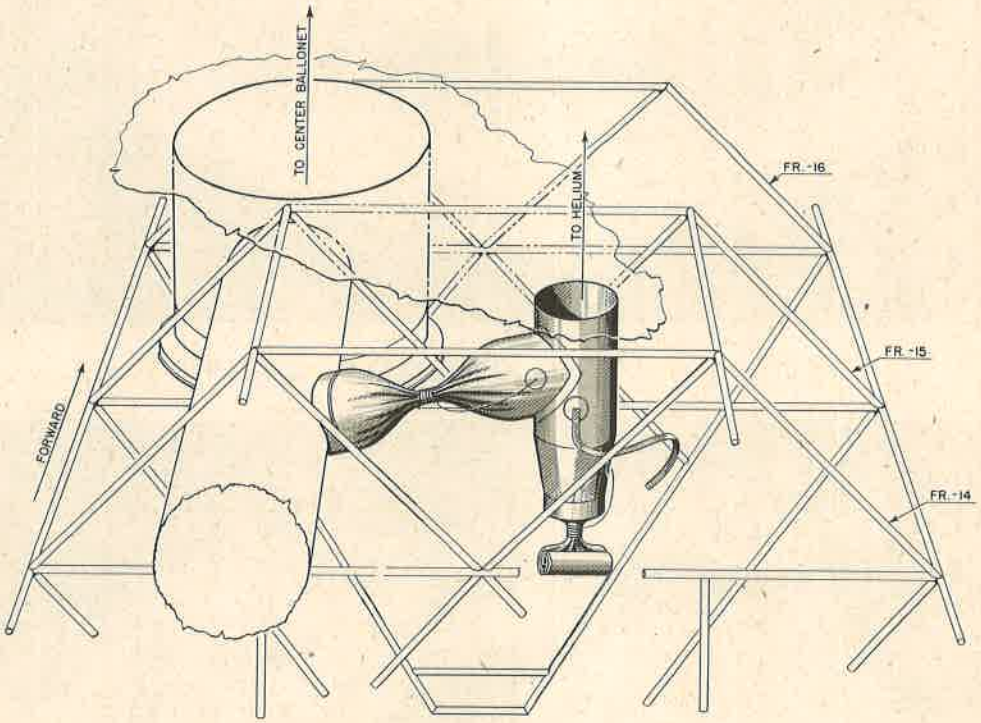


FIG. XII - AIR TO HELIUM SLEEVE (FORWARD)

8. Air-to-Hellum Sleeves

Two air-to-hellum sleeves connect the air system to the gas compartment. The forward sleeve, which forms a "Y" connection with the helium inflation sleeve is located in envelope panel 44 (panel 43 for the M-2, M-3 and M-4) and is connected with the port blower and air chamber system. The after sleeve is located in panel 48 (panel 47 for M-2, M-3 and M-4) and is connected with the starboard blower and air chamber system. Each sleeve is normally tied off around a 2-inch diameter rubber plug with rubberized cord and tagged with a red emergency tag. Both sleeves remain tied off at all times during normal flight operations and should be untied only to blow air

into the gas compartment to maintain envelope pressure in case of emergency. (Dwg. 6092-616, 4092-53 and -54).

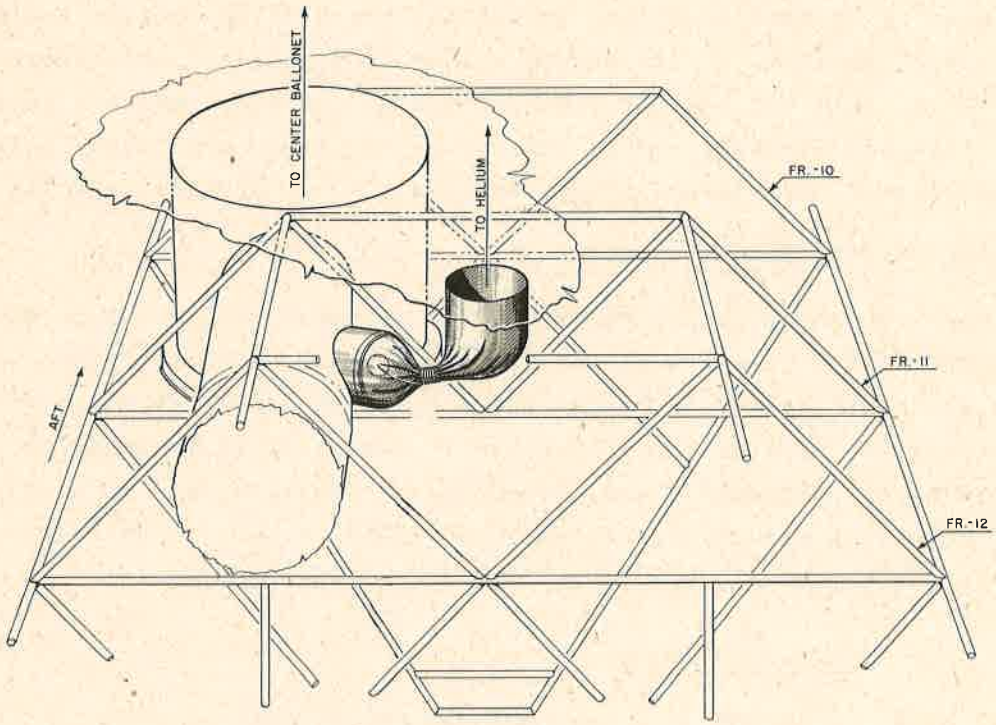


FIG. XIII - AIR TO HELIUM SLEEVE (AFTER)

9. Air System Capacity

The air scoops, ducts and damper valves are of sufficient capacity to maintain a pressure of 1.25 inches of water at the gas manometer in the car when the airship is descending at the rate of 1200 feet per minute, and at a forward speed not greater than 50 knots.

The air valves and ducts are of sufficient capacity to allow the airship to rise at a velocity of 2400 feet per minute below pressure height without discharging gas, and without the air pressure exceeding 2.5 inches of water. The two auxiliary blowers have sufficient capacity to maintain a pressure of 0.5 inches of water at the gas manometer when the airship is falling without power at approximately 600 feet per minute.

I. HELIUM INFLATION SLEEVES

An 8-inch diameter inflation sleeve is provided for adding helium to the gas chamber. This sleeve is located in the top of the car on the starboard side at panel 44 (Panel 43 for M-2, M-3 and M-4) and forms a "Y" connection with the forward air-to-helium sleeve (Dwg. 6092-32, 4092-43). Normally, this sleeve is tied off, around a 2-inch diameter rubber plug, with rubberized cord (Dwg. 4092-54).

For envelope inflation during erection only, two inlets with 8-inch diameter appendix sleeves are provided in the envelope (Dwg. 630-1550). The after sleeve is located 12 inches to the starboard of the bottom centerline of the ship at panel 94. The forward sleeve is located on the centerline of gore "B" at panel 12. After the envelope is inflated, these sleeves are tied off by means of rubber plugs and rubberized cord, and tucked into the envelope. Covers, buckled in place, provide a flush surface over the sleeves.

J. MANHOLES AND INSPECTION SLEEVES

Four 18-inch diameter manholes with appendix sleeves (Dwg. 6092-51) are provided in the envelope at the forward, center, and after ends of the car to give access to the ballonets and air lines. The appendices of the sleeves are tied off around 2-inch diameter rubber plugs by means of rubberized cord and normally are stowed inside the ballonets or airlines with the manhole areas covered by means of laced nets. The manholes are located at the top of the car in the following envelope panels:

M-1	M-2, M-3 and M-4	
#27	#28	Access forward ballonet
#43	#42	Access forward equalizer duct, center ballonets
#49	#48	Access after equalizer duct, center ballonets
#61	#60	Access after ballonet

An 18-inch manhole with an appendix sleeve is located on the starboard side of panel 58 (panel 57 for M-2, M-3 and M-4) at the top of the car to provide access to the gas chamber.

Inspection windows and sleeves are provided in the bottom of the envelope, one at panel 35 and one at panel 58 (panels 36 and 57 for M-2, M-3 and M-4) for visual inspection of the envelope interior.

K. GAS VALVES

Two 36-inch diameter gas valves (Dwg. 6092-690) are installed in the upper part of the car, one on the port side between frames 4 and 5, and one on the starboard side between frames 20 and 21 (Dwg. 3092-132).

The valves are shock mounted on rubber bushings and are connected to the gas space of the envelope by means of an accordion type sleeve (Dwg. 4092-50). This improved type sleeve permits easy valve removal or replacement without loss of helium.

A fabric gas chamber for each gas valve conveys the discharged gas to

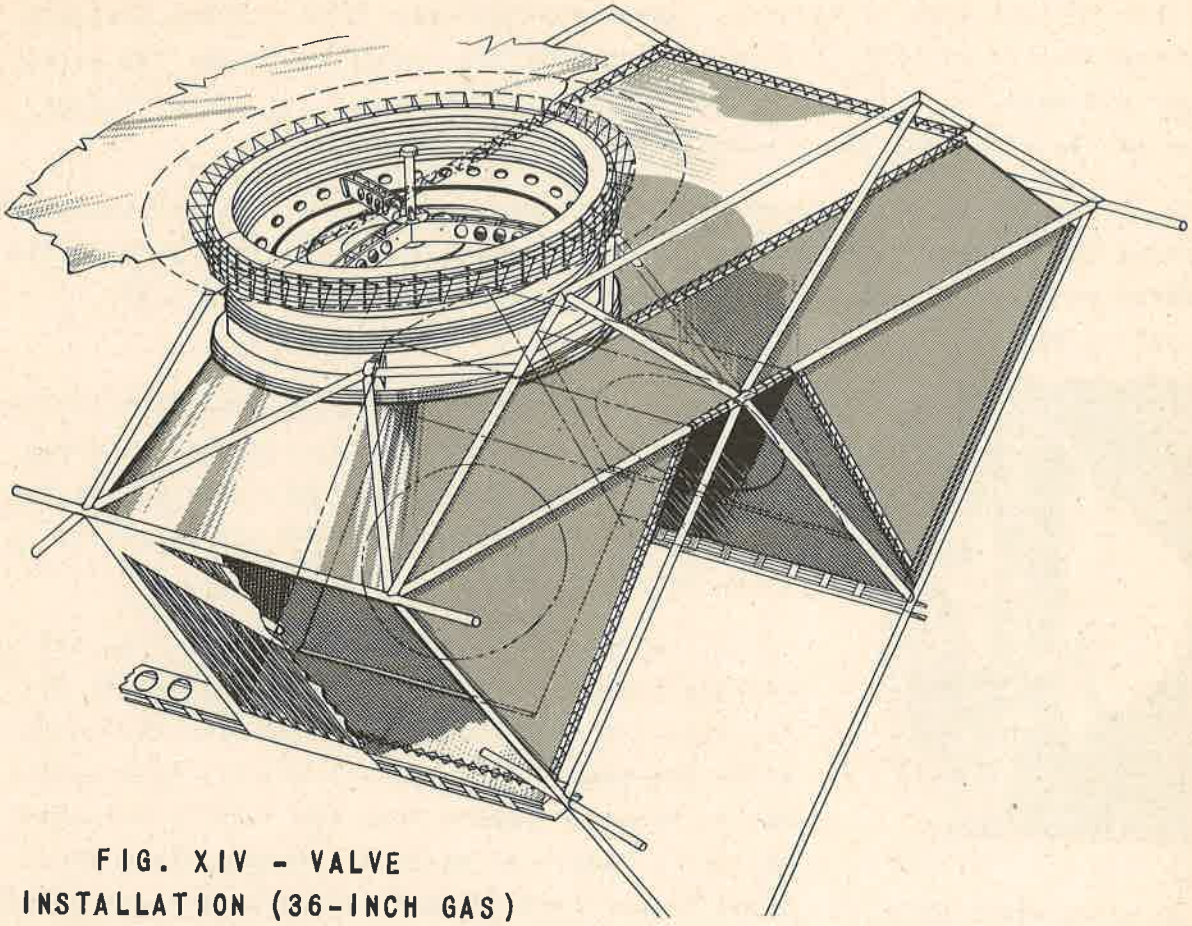


FIG. XIV - VALVE INSTALLATION (36-INCH GAS)

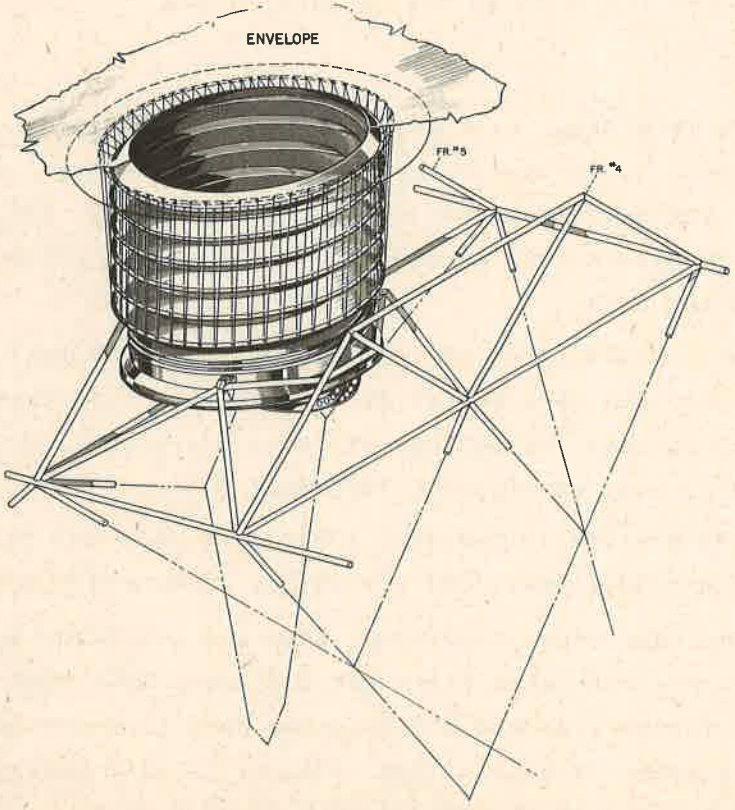


FIG. XV - HELIUM VALVE SLEEVES

louvers on each side of the car. (Dwg. 5092-387 and -388). These chambers are constructed of Q37A1 fabric and laced to the frames or supporting wires by Cord-O-Hyde. A 6-inch Plexiglass window is installed for visual inspection of the valve and is accessible from the car interior.

The valves are entirely automatic, but in addition, are equipped with opening and closing control lines which terminate at the pilot's panel. The opening setting of each valve is locally adjustable by means of three adjusting knobs.

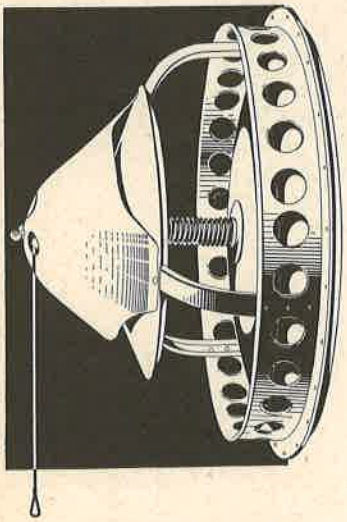


FIG. XVI-EMERGENCY VALVE (20-INCH)

The gas valves are of sufficient capacity to permit the ship to rise above pressure height at a rate of 1800 feet per minute without the gas pressure at the manometer in the car exceeding 3.00 inches of water.

A 20-inch gas valve (Dwg. 6092-100) for emergency use is provided in panel 33 (panel 34 for M-2, M-3 and M-4) on the port side 24 inches above the seamline of gores C and D. This valve may be manually opened from the pilot's compartment by a length of sash cord leading from the valve to car frame 23 and thence to a toggle pull knob on the pilot's panel.

L. BOW STIFFENING

The bow is reinforced by a semi-rigid nose stiffening assembly (Dwg. 6092-437) (Dwg. 6092-841 for M-4 only) consisting essentially of a 14-foot 11-inch diameter, built up, aluminum alloy nose cone (Dwg. 6092-370) with thirty-two radially and equally spaced battens hinged by universal joints to the outer edge of the cone.

The battens, constructed of wood and covered with fabric are located on the centerline of each gore and on the gore seam. Each batten is secured to the envelope by lacings and patches at intervals along its length and by a two-finger patch on the envelope at its after end.

The battens are of two lengths, sixteen of them are 25.5-feet long and the remainder are 15.5-feet long, installed alternately around the cone.

The long battens are 1-1/2-inches wide and 5-1/8-inches deep at their maximum cross section, both ends being tapered (Dwg. 5092-442). The short battens are 1-1/2-inches wide and 4-3/8-inches deep at their maximum cross section, both ends being tapered. (Dwg. 5092-441). All battens are shaped to conform to the contour of the envelope.

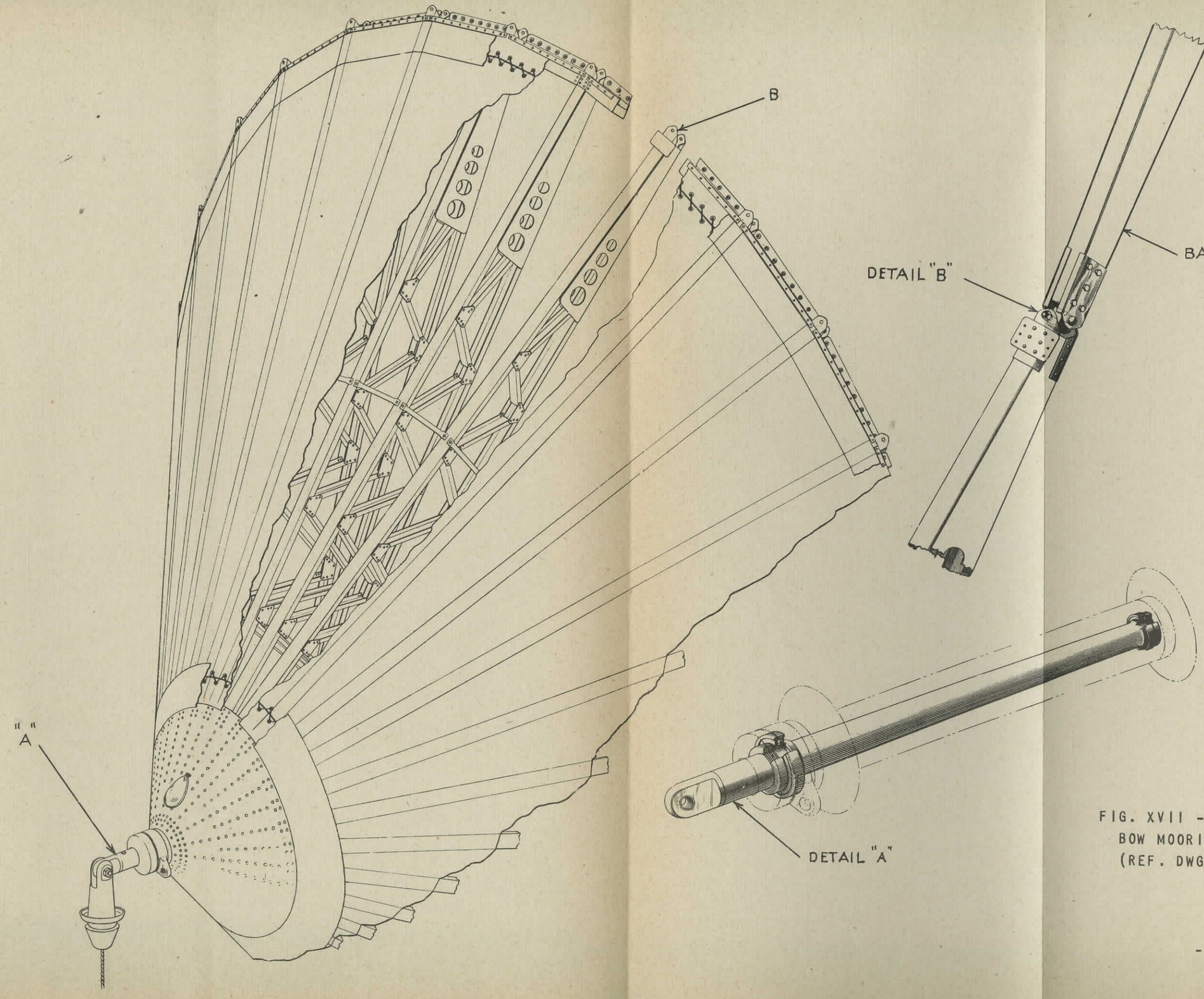


FIG. XVII - NOSE CONE AND BOW MOORING ASSEMBLY (REF. DWG. 6092-437)

Each batten is constructed of two cap strips of 1/2-inch by 1-1/4-inch spruce, glued to 1/8-inch 3-ply mahogany faced plywood sides to form a hollow spar. Spacer blocks of spruce are provided every 12 inches throughout the length of the batten. The built-up batten is covered with cotton fabric, Spec. Q13A8, glued in position and then doped with two coats of acetate butyrate dope and two coats of non-specular gray laquer.

The batten hinge point details are shown on drawings 2092-439, 6092-441, and 6092-442. See also detail B, Figure XVII.

The nose cone, constructed of radially tapering aliminum alloy members, is attached to the envelope by lacing to a lacing strip on the envelope surface, located circumferentially at the outer edge of the nose cone.

The nose cone assembly is provided with a fabric cover. In addition, a fabric cover extends aft, completely covering the short battens (Dwg. 1092-509). On M-4 only, this cover is eliminated and thirty-two small fairing panels (Dwg. 3092-844) are laced into position to serve as a fairing between the nose cone and the envelope. (Dwgs. 6092-370 and -437 and -841).

M. BOW MOORING

The ship is moored to the mast by means of a steel mooring cone which hangs from the forward end of a horizontal mooring spindle at the bow (Dwg. 6092-437).

The cone (Dwg. 2092-517) is of standard design and equipped with a mooring pendant 50-feet long of 3/8-inch diameter (7 x 19) stainless steel cable. The cable is attached to the cone by means of a swedge fitting seating in a ball bearing socket. The M-4 airship was temporarily equipped at delivery with a non-swiveling, zinc filled cone.

An 80-foot length of 1/4-inch diameter sash cord (Dwg. 2092-75-1) with a snap fastener serves as a retrieving line for the pendant cable in flight.

The mooring spindle (Dwg. 2092-518) is free to revolve about its longitudinal axis in ball bearing mounts. The forward bearing is mounted in the front hub housing (Dwg. 3092-374) of the nose cone assembly (Dwg. 6092-370) while the after bearing is housed in the rear hub (Dwg. 2092-375) of the nose cone. These steel bearing hubs are riveted directly to the bow mooring hub (Dwg. 4092-373) of the nose cone assembly. The forward bearing is of the radial thrust type (212-DD) and takes all of the longitudinal loads on the spindle. See detail A, Fig. XVII.

N. HANDLING LINES

The handling lines (Dwg. 6092-20 for M-1, M-2 and M-3; 5092-821 for

M-4) are distributed as follows:

LOCATION		DRAWING NO.
Forward Car (Frame 27)	1 pair	2092-70-10
Forward Car (Frame 22)	1 pair	2092-70-1
Mid-Car (Frame 8)	1 pair	2092-70-2
Aft-Car (Frame 3)	1 pair	2092-70-3
Lower Vertical Fin	1 pair	2092-76
Quarter Line, Stern	1 pair	1092-394 (M-1, M-2 & M-3)
Quarter Line, Stern	2 pair	1092-840 (M-4)
Yaw Line, Bow	1 pair	2092-72
Drag Line, Car	one	2092-74

The two yaw lines attached to the nose mooring spindle are 144-feet 9-inches in length, 5-feet of which is 7/32-inch diameter (7 x 19) stainless steel wire cable, while the remaining 139-feet 9-inches is 3/4-inch diameter manila rope. Before flight, the free ends of these lines are coiled and placed in yaw line boxes on either side of the forward end of the car. The covers of the boxes are provided with releases and when opened, permit the ropes to fall out.

A drag rope, 150-feet long of 3/4-inch manila rope with 6-feet of 7/32-inch (7 x 19) stainless steel cable at its securing end, is attached to the car at frame 3. Normally this rope is coiled and stowed in a box in the after end of the car. The coiled line may be released by a quick release mechanism on the box cover, operable from the pilot's position.

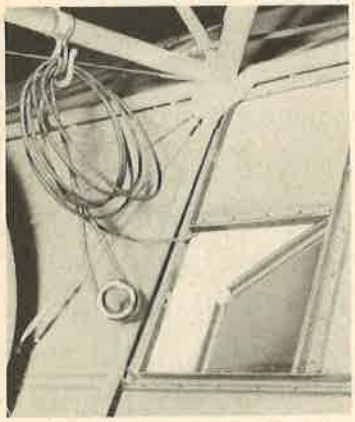
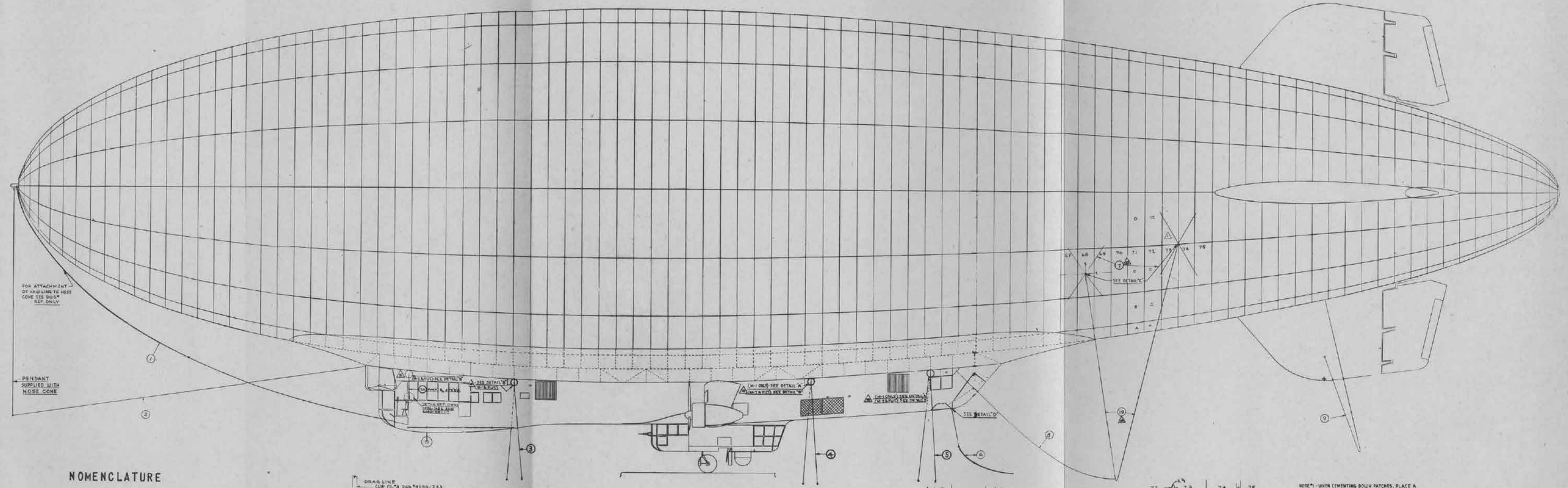


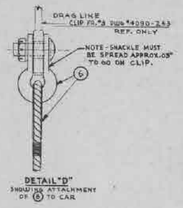
FIG. XVIII-TYPICAL CAR HANDLING LINE STORAGE

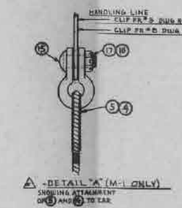
Port and Starboard handling lines are attached by shackles to clips on the car at frames 3, 8, 22 and 27. The handling lines are 7/32-inch diameter (7 x 19) wire cables, equipped with hollow rings for attachment of ground handling ropes. The handling lines on the forward section are 18 feet long, those on the center section 19 feet long, and those on the after section 20 feet long. During flight, these handling lines are coiled and stowed on handling line hooks, located inside the car near the attachment points of the lines to the structure. Similar lines at frame 27 are 4-feet 7-1/2-inches long, and are held taut against the car exterior during flight by exerciser cord. Rubber grommets on the line prevent chafing the car surface.

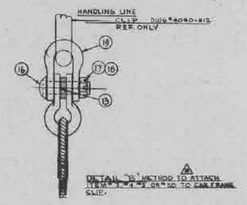


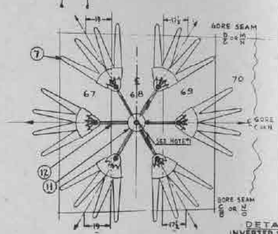
NOMENCLATURE

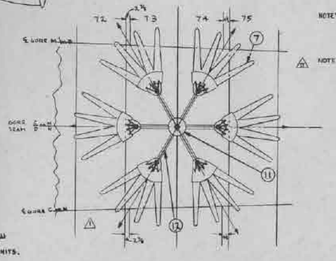
1. Yaw Line - Nose Cone
2. Pendant Retrieving Line
3. Handling Lines - Forward Car Frame 22
4. Handling Lines - Middle Car
5. Handling Lines - After Car
6. Drag Line - Car
7. Assembly - Patches - Quarter Line
8. Quarter Line Unit Retrieving Line
9. Handling Lines - Lower Vertical Fin
19. Quarter Line Unit
20. Handling Lines - Forward Car Frame 27











NOTE 8 - WHEN CEMENTING DOWN PATCHES, PLACE A BLOCK 9" HIGH UNDER CONCENTRATION RING, AND LOCATE PATCHES TO TAKE UP SLACK IN CABLES BETWEEN RING AND PATCHES.

NOTE 9 - ITEM 9 TO BE ATTACHED AT POINT OF INTERSECTION, AND NOT ROLLED UP WITH ENVELOPE.

FIG. XIX - HANDLING LINES
(DRAWING 6092-20)

A quarter line is suspended in a bight on each side of the envelope forward of the fins. Each end of the quarter lines is attached to the envelope by a cluster of six four-finger patches. Stainless steel wire cables 3/16-inch diameter (7 x 19) bridle from a central concentration ring to the six patches on the envelope. Stainless steel wire cables 1/4-inch diameter (7 x 19), approximately 80 feet in length, are attached at each end to these concentration rings (Dwg. 3092-73).

The forward end of the port quarter-line is located at the centerline of gore C at the centerline of panel 68, while the after end is centered on the seamline of gores C and D, at the seams of panels 73 and 74. The starboard quarter-line is similarly attached. The forward end is located at the centerline of gore N at the centerline of panel 68, while the after end is located at the seams of gores N and M at the seams of panels 73 and 74.

The installation of the quarter-lines differs on the M-4 airship in the following respects. Two additional sets of four 4-finger patches are installed on the bottom centerline of the envelope, one set centering at panel 68 and the other at the seamline of panels 74 and 75. From the concentration ring of the forward bottom unit a 70-foot, 7/32-inch diameter stainless steel cable runs in the form of a bight to the concentration ring of the starboard unit in gore N panel 68. A similar line extends from the forward bottom unit to the port unit in gore C panel 68. The after units of the quarter-lines are similarly connected. Two 75-foot lengths of cable extend in the form of bights from the bottom after unit to the units at the seamline of panels 73 and 74 gores C and D on the port side, and panels 73 and 74 gores M and N on the starboard side. The handling lines are held clear of the major control lines at each end of the bottom units by two 30-inch lengths of exerciser cord attached to the envelope by #10 patches.

Two retrieving lines consisting of 45-foot lengths of 1/4-inch sash cord run from the stern of the car to the quarter-lines. After takeoff the quarter-lines may then be pulled taut to the car. On the M-4 airship the port quarter-lines are connected together by a 24-foot length of 1/8-inch diameter stainless steel cable equipped with snap fasteners. The starboard lines are likewise connected together and each connecting line attached to each retrieving line by a snap fastener.

Stern handling lines drop from the lower vertical fin in the form of a bight on both the port and starboard sides. Each line consists of 5/32-inch diameter (7 x 19) stainless steel wire cable, approximately 48-feet long, attached by shackles to clips on the fin structure (Dwg. 2092-76). These lines hang free in flight. A restraining clip is mounted on the fairlead bracket (Dwg. 3091-406) and a cable retaining clip (Dwg. 1091-408) at the bottom on each side of the fin. Before flight, each cable may thus be placed over the

fairlead clip and under the retaining clip to prevent chafing the fin surfaces. Cable stops on the lines prevent excessive looseness.

O. RIP PANELS

There are two rip panels, each approximately 20-feet long, located 20-inches off the top centerline of the envelope in gore H, one extending from panel 22 to panel 29, and the other from panel 62 to panel 69 (Dwg. 4092-19 for M-1; 4092-619 for M-2, M-3 and M-4).

They are of standard type and are pulled open by 3/8-inch diameter sash cord leading from the panels to the port side of the car. The rope from the forward panel terminates close to the forward car door; the rope from the after panel ends adjacent to the after car port windows. The ropes are dyed red in order to differentiate them from all other lines on the ship. At the points where the rip panel cords pass through the envelope, a double-eye connector and gas-tight gland is provided.

The rip cord inside the envelope is tied to patches on the envelope at four different points with a breakable 3-ply waxed linen cord. The rip cords are marked for the location of these tie-offs to insure that they will be installed with sufficient slack.

P. PITOT-STATIC TUBE

Attached to the envelope by three lacing patches and located on the starboard side at the seamline of gores N and O, and panels 37 and 38, is a tripod bracket of aluminum alloy tubing extending approximately 2-feet from the envelope and mounting a pitot-static tube (Dwg. 4079-3868). This tube is used for measuring the dynamic air pressure and the true static air pressure for the air speed meter and manometers. Two 3/16-inch I.D. by 1/16-inch wall Neoprene tubes lead from the pitot-static tube through a fabric conduit on the exterior surface of the envelope to the car, terminating at frame 27.

Q. PRESSURE TUBE SYSTEM

A pressure system is installed (Dwg. 6090-7893) for observing the air speed, the static air pressure, the gas pressure in the gas compartment, and the air pressure in the various ballonets. Flexible rubber tubes 3/16-inch I.D. lead from the gas and air compartments to a central station on the port side of the car at frame 27 (Dwgs. 4092-24, -302 for M-1; 4092-620,-621 for M-2 and future). From this central station 1/4-inch O.D. 2S½H aluminum alloy tubes lead directly to the pilot's instrument panel (Dwg. 6090-7893).

A frustum shaped fabric partition separates the gas space from the tube outlet to the gas manometers. This air chamber assembly is equipped with an air inflation valve and an inspection window for determining the degree of

inflation. (Dwg. 3092-720). This frustum serves as a diaphragm, transmitting the gas pressure by a head of air, thus giving a more accurate reading at the instrument panel of the gas pressure, regardless of the pitch angle of the airship.

The various pressure tubes are as follows:

From	To	For	Gland Location M-1 Panel	Gland Location M-2 & Fut. Panel
After Ballonet	Liquid Manometer	After Ballonet Air Pressure	64	63
Center Ballonet Duct	Liquid Manometer & Middle Ballonet Fullness Indicator.	Middle Ballonets Air Pressure	48	48
Gas Space - Envelope	Mechanical Manometers & Middle Ballonet Fullness Indicator.	Gas Pressure	46	45
Gas Space- Envelope	Purity Meter Outlet	Purity Meter Attachment	29	30
After Ballonet	Liquid Manometer	Forward Ballonet Air Pressure	27	27
Pitot Tube (Dynamic)	Air Speed Meter	Dynamic Air Pressure	-	-
Pitot Tube (Static)	Air Speed Meter, Altimeter, Rate of climb Indicator, All 5 Manometers.	True Static Air Pressure	-	-

R. SUPERHEAT THERMOMETER INSTALLATION

A Bureau of Standards superheat thermometer is installed in the airship (Dwg. 4092-301 for M-1; 4092-624 for M-2, M-3 and M-4). The two air elements of the instrument are located on the outside of the envelope, one at each side of the ship on panel 28 (panel 27 for M-1) 9-inches above gore seams B-C and O-N, respectively. They are attached to the envelope by means of lacing patches (Dwgs. 2080-105, -106). The gas element is suspended inside the envelope by an elastic suspension cable system hanging from the internal catenary suspension cable system at panel 35. In its normal position the element is approximately 33-feet above the bottom of the envelope. The suspension cable for the gas element is carried over a pulley system which permits adjustment of the element

at various heights in the bag or its complete removal and reinstallation without bag deflation. This cable is held taut by a 5-foot length of exerciser cord.

A gas tight sleeve is provided in the envelope where the line to the gas element passes through the envelope into the gas chamber. This gland is located in panel 35 (panel 34 for M-1) inside the car fairing.

All necessary cable leads to the air elements (furnished with the instrument) are run through a fabric conduit (Dwg. 610-1582) on the surface of the envelope.

The indicating meter is mounted in the pilot's instrument panel (Dwg. 4090-1078); the 22-1/2-volt battery for the system is mounted on the back of the panel.

S. BONDING AND LIGHTING

All metal parts, including the fins and nose cone, are electrically bonded to the car. The bonding of braided sleeving and shielded cable is run through fabric conduit on the envelope surface and separated from the envelope by a layer of asbestos. (Dwg. 6092-321 for M-1; 6092-618 for M-2, M-3 and M-4)

Running lights are installed on the envelope, the fins, and the car. The three envelope lights are attached to the envelope by chafing and attachment patches. (Dwg. 610-1587 and 2080-88). The car, fin and nose cone lights are bolted directly to their respective surfaces or to brackets riveted to that surface.

The lighting system on the envelope and fins consists of seven lights that operate simultaneously as flashers; with the lights "ON" approximately two-thirds of the cycle, regardless of the frequency. Lights are as follows:

LOCATION	COLOR
Nose Cone	White
Panels 41-42* Port Horizontal Equator	Red
Panels 41-42* Starboard Horizontal Equator	Green
Upper Vertical Fin, Outboard Edge	White
Port Horizontal Fin, Outboard Edge	Red
Starboard Horizontal fin, Outboard Edge	Green
Panel 96, Stern	White

* Panels X-Y for M-2, M-3 and M-4.

Running and propeller clearance lights on the car do not flash and are

located as follows:

LOCATION	COLOR
Frame 26 Port Side	Red
Frame 26 Starboard Side	Green
Frames 27-28 Under Side	White
Frame 15 Port Side (Propeller Clearance)	White
Frame 15 Starboard Side (Propeller Clearance)	White

All lights are located to give maximum all around visability. However, they are shielded to prevent them from illuminating the airship. See "Electrical System" for type and size.

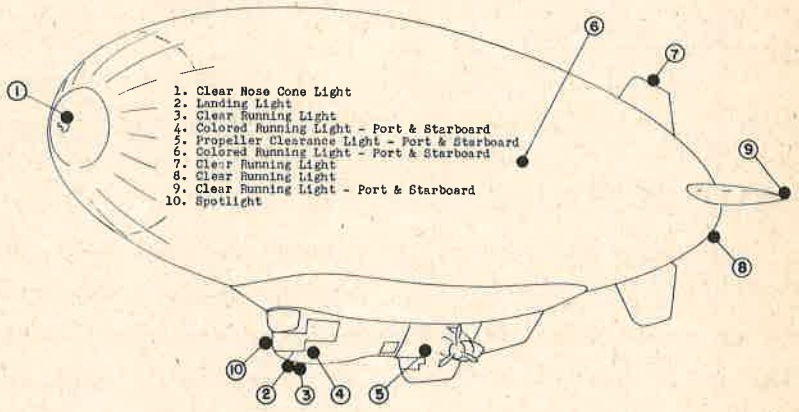

1. Clear Nose Cone Light
2. Landing Light
3. Clear Running Light
4. Colored Running Light - Port & Starboard
5. Propeller Clearance Light - Port & Starboard
6. Colored Running Light - Port & Starboard
7. Clear Running Light
8. Clear Running Light
9. Clear Running Light - Port & Starboard
10. Spotlight

FIG. XX - RUNNING LIGHT LOCATION SKETCH

A retractable landing light is located in the bottom of the car between frames 27-28 and a spotlight on the starboard side at frame 28.

T. CAR FAIRING

A fabric fairing (Dwg. 6092-27) is installed between the car and the envelope, completely covering the outside suspension cables and forming a streamlined junction between the car and envelope. The fairing is constructed of single-ply rubberized fabric Q37A1 in twenty sections or panels. These panels are laced in position with #9 waxed linen cord to lacing strips on the outside catenary curtain and to tubing and lacing strips on the car structure. Sealing strips are then cemented over the lacing to form a smooth exterior surface. (Dwg. 5092-26 for M-1; 5092-627 for M-2 and future).

Two "L" shaped inspection openings with zipper fastenings are provided in the forward end of the fairing.

U. ENVELOPE MARKINGS

The envelope markings are in accordance with specification SR-2C and include:

(a) Designation - U. S. Navy	Drawing 1080-542
(b) Class lettering (Removed)	" 2080-641
(c) Star Insignia	" 620-1650
(d) Manufacturer's Marking	" 630-1549

V. MISCELLANEOUS PATCHES

1. Plumb Bob Patches

Six plumb bob patches, three per side, are located on the envelope at the equator. They are distributed longitudinally on both sides, at the seam lines of gores D-E and L-M, respectively, at panels 19, 42, 71 (Dwg. 610-5). At the center of each patch is a 1-inch cord becket, to which a plumb-bob line may be attached during erection.

2. Flag Patches

There are two patches at the stern of the ship, each containing a cord loop, for attachment of the ship's flag (Dwg. 610-8 and 630-1581).

3. Control Cable Guide Patches

Four #13 four-finger patches (Dwg. 630-13), four lacing patches (Dwg. 3080-856), and two chafing patches (Dwg. 3092-381-5) are installed on the bottom centerline of the envelope for support of the major control line guide. (See Major Controls). They are located in panels 68 thru 69 for M-1, M-2 and M-3 (Dwg. 3092-381); panels 70 thru 73 for M-4 (Dwg. 3092-823), centered on the seam line of gores A and P.

4. Fairlead and Pulley Bracket Patches

A total of four fairlead and pulley bracket patches are installed in panel 84, midway between the fin surfaces, for the attachment of control line guides. Fairlead patches (Dwg. 630-1701) are installed between the upper vertical and horizontal fins, and pulley bracket patches (Dwg. 3092-257) between the lower vertical and horizontal fins.

5. Antenna Patches

Three antenna base patches (Dwg. 5080-775) are located in gore 0 panels 18, 29, 35 and three antenna supporting patches (Dwg. 620-4) in panels 19, 29, 34 for attachment of the radio antennae. (Panels 17, 28, 34 and 18, 28, 33 respectively for M-1 only).

6. Compass Transmitter Patch

An attachment patch (Dwg. 630-1623 and -1625) is located in gore 0 panel 26 (panel 25 for M-1 only) for the attachment of the magnetic compass transmitting unit.

W. RAIN DRIP

A 3/4-inch rain drip is attached to the envelope at the junction line of the outside catenary and the envelope extending completely around the car except at the after end. (Dwg. 5092-316 for M-1; 5092-631 for M-2 and future).

This location is such as to prevent moisture from dripping on the car or power plants under all ordinary conditions.

The rain drip is constructed of rubberized duck covered with ballonet fabric and cemented in place.

X. FIN SUSPENSION AND PATCH LOCATION

The fins are suspended from the envelope by means of a system of brace cables and catenaries, Fig. XXI, with additional attachments at the fin bases (Dwgs. 4092-86 for M-1; 4092-829 for M-2, M-3 and M-4).

Fin base chafing strips are provided for protecting the envelope where contact is made with the bases of the fixed surfaces. The chafing strips are of air-tight envelope fabric and conform to the shape of the fin base (Dwg. 5092-83, -84, -85 for M-1 and M-2; 5092-825, -826, -827 for M-3 and M-4). Chafing strips are installed between the fin base and finger patches plus a chafing patch (Dwg. 61070-246) at the three-finger patches at each end of the fin bases.

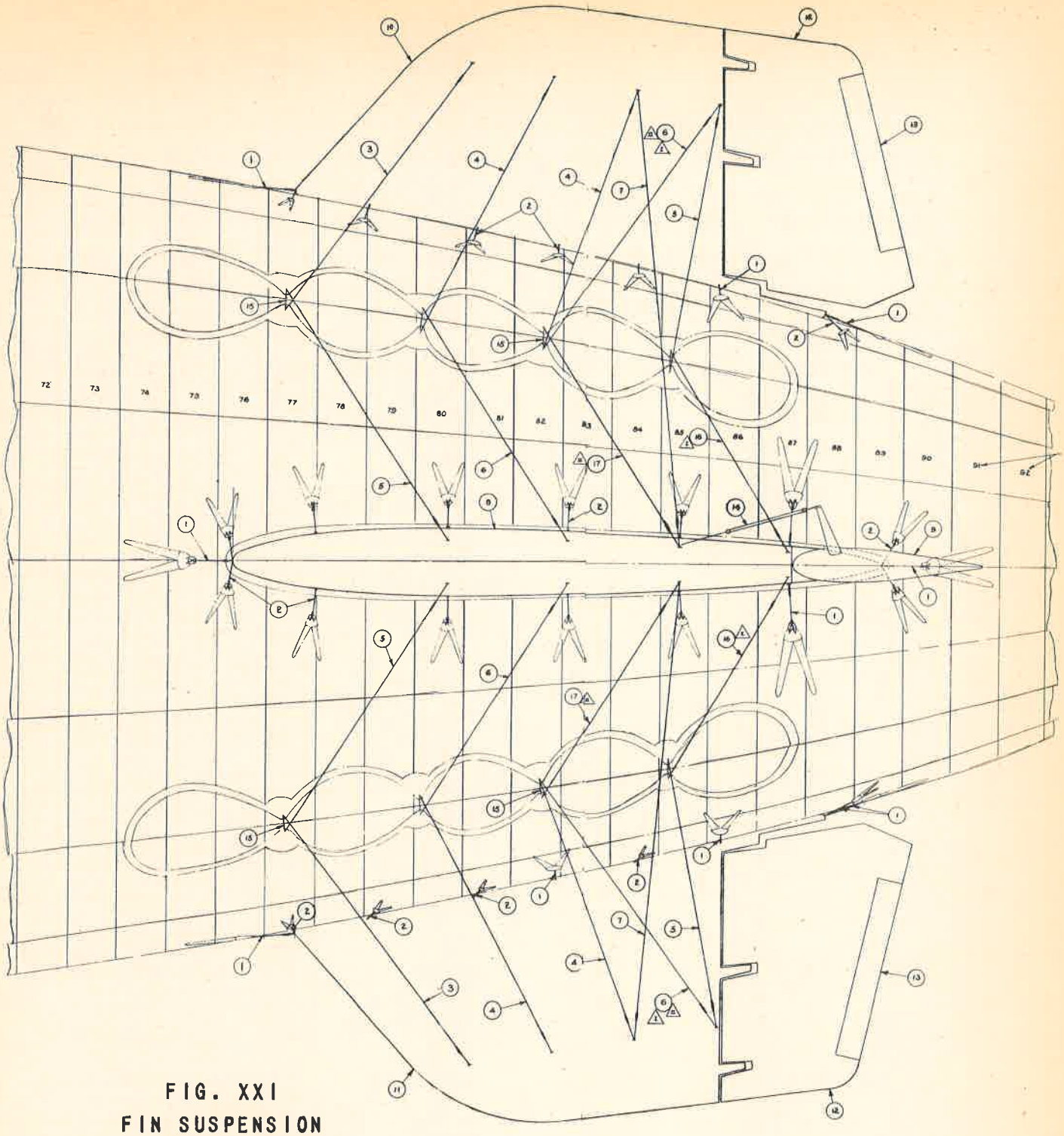
Around each fin base sixteen 2-finger patches are symmetrically located and cemented to the envelope. Of these a 2-finger patch is located at each end and in line with the fins for securing the fins against fore-and-aft movement. Seven 2-finger patches are located on the envelope on either side of each fin to secure the fins against transverse forces (Dwg. 4092-82 for M-1 and M-2; 4092-824 for M-3 and M-4). The leading and trailing edges of all fins may be adjusted a distance of 3-inches either side of the base centerline, a total adjustment of six inches for each fin.

The brace cable system of each fin is secured to the envelope surface through the medium of fin catenaries (Dwg. 5092-315). Four fin catenaries are cemented to the envelope at gore seams B-C, J-K, F-G and N-O. The centerline of each catenary coincides with its respective gore seam. Each catenary provides four cable suspension points for each of its two adjacent fins, each curtain being located equidistant from the two neighboring fins (Dwgs. 6092-86 for M-1; 4092-829 for M-2, M-3 and M-4). Thus, each vertical fin is supported by ten brace cables to the fin catenary system, five to a side, and each horizontal fin is supported by eight brace cables, four to a side; in addition to one box cable between each fin. The brace cables of stainless steel per Spec. AN-RR-C-48 vary in size from 5/32-inch to 3/8-inch diameter according to location (see Fig. XXI). They are looped around split thimbles at each end and fastened by Nicopress fittings. All brace cables are equipped with turnbuckles for the maintenance of proper cable tension and are fastened to the fins and catenaries by shackles.

The catenaries are constructed of Q13A17 and Q65A6 fabric, terminating

In eight concentration points (Dwgs. 5092-310, -315 for M-1; 5092-645, -646 for M-2, M-3 and M-4). At each of these points an aluminum alloy ring is laced into the catenary to provide an attachment point for the fin brace cables. The edge of the catenary is reinforced by a 7/32-inch diameter carbon steel cable which also aids in securing the concentration rings. (5/32-inch and 7/32-inch for M-1 catenaries only.

The opposing concentration points are connected together with strap cables. Chafing strips are cemented to the envelope to protect it from abrasion at these points.



PORT ELEVATION

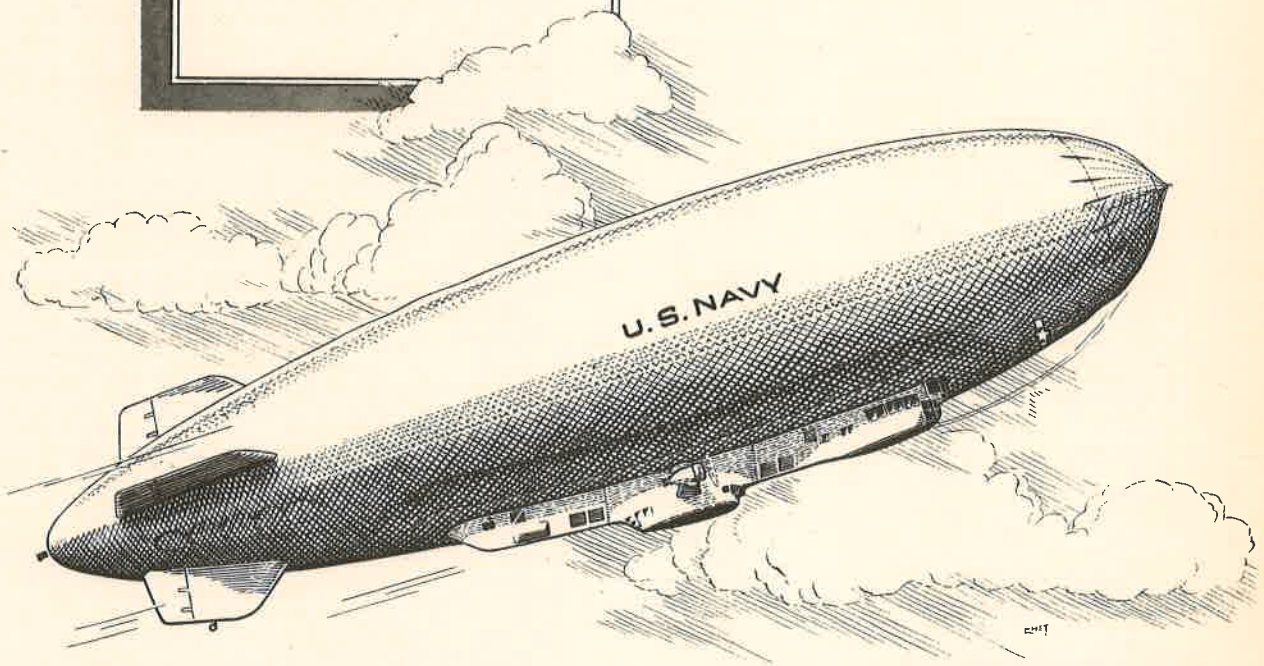
FIG. XXI
FIN SUSPENSION
(REF. DWG. 6092-86)

NOMENCLATURE

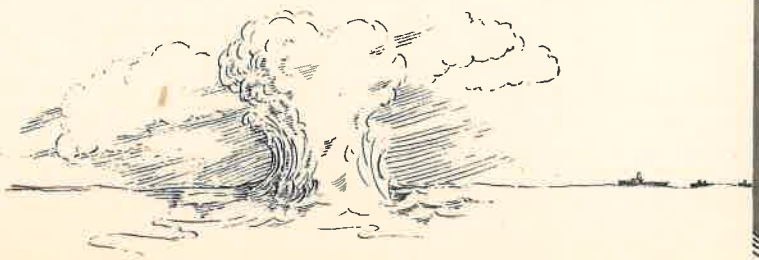
1. Fin Brace Cable (Inboard)
2. Tie Cable - Assembly
3. Fin Brace Cable (1/4")
4. Fin Brace Cable (5/32")
5. Fin Brace Cable (1/4")
6. Fin Brace Cable (3/16")
7. Fin Brace Cable (3/16" Box Cable on M-1; 5/32" Box Cable on M-2, M-3 and M-4)
8. Horizontal Fin
9. Elevator
10. Upper Vertical Fin
11. Lower Vertical Fin
12. Rudder
13. Rudder Tab
14. Elevator Balancing Device
15. Fin Catenary Strap Cable
16. Fin Brace Cable (3/8")
17. Fin Brace Cable (7/32")

Part III

The Empennage



Goodyear "M" Airship



- THE EMPENNAGE -

A. GENERAL DESCRIPTION

The four fins with bases conforming to the contour of the envelope are located in the vertical and horizontal longitudinal planes of the airship near the after end (Dwg. 6092-86 for M-1; 4092-829 for M-2, M-3 and M-4). They are supported on the envelope by a system of brace and tie cables attached to finger patches and catenaries on the envelope surface.

A movable surface with three hinge points is attached to the trailing edge of each fin. The two elevators are statically balanced in their neutral position by bungee devices between the upper elevator horns and upper fin surfaces (Dwg. 2092-376). The two rudders are equipped with servo-tabs in their trailing edges (Dwg. 6091-5).

The two horizontal fins and elevators are respectively similar in size and design as are the two vertical fins and rudders. A swiveling tail wheel is mounted on the lower vertical fin for protection during ground operation.

B. STRUCTURE

The fin and movable surface structures are built up of longitudinal and transverse aluminum alloy trussed frames of 24ST Alclad conforming to Spec. AN-A-13 riveted together, and braced with steel wire per Spec. AN-aa-W-429. The outboard and trailing edges only are 24ST aluminum tubing.

C. COVERING

The fixed and movable surfaces are covered with BB cotton fabric 2.9 oz. per sq. yd. sewn together and doped in place. Laps and edges are covered with HH cotton tape and all surfaces which might chafe the envelope are covered with 1/16-inch thick white felt. Exposed edges of the gussets and rivet heads on the metal framework are covered with 1/2-inch industrial tape and 1-inch adhesive cellophane before the fabric cover is applied.

All covers are provided with drainage holes to prevent the collection of water inside the surfaces, and additional holes are provided for adequate ventilation. Inspection openings and plates are provided where necessary.

D. FABRIC FINISH

After the cover seams are secured and the first coat of acetate dope applied, the cotton sealing tape is placed over the seams. This is followed by two additional brush coats of clear acetate butyrate dope Spec. M-390, and by two spray coats of light, non-specular, grey-pigmented, acetate butyrate dope Spec. M-520. (When pre-doped tape is used, it is applied between the

second and third coats).

E. HORNS, HINGES, STOPS, POSITION TRANSMITTER AND SERVO-TABS

The control cables for each surface terminate at horns located on each side of the movable surfaces (Dwg. 4091-617-2). The horns are constructed of aluminum alloy sheet with steel fittings at their tops and aluminum alloy fittings at their bottoms. Wires from the top of the horn to the outer edge of the surface serve as braces.

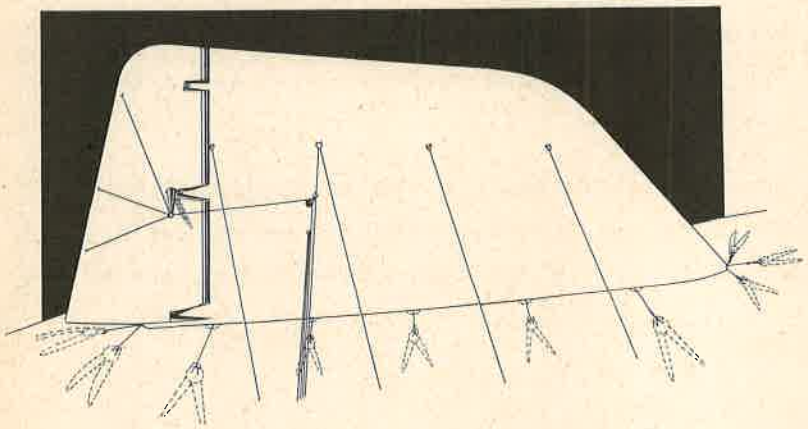


Fig. XXII
STARBOARD HORIZONTAL FIN
(Viewed from Underside)

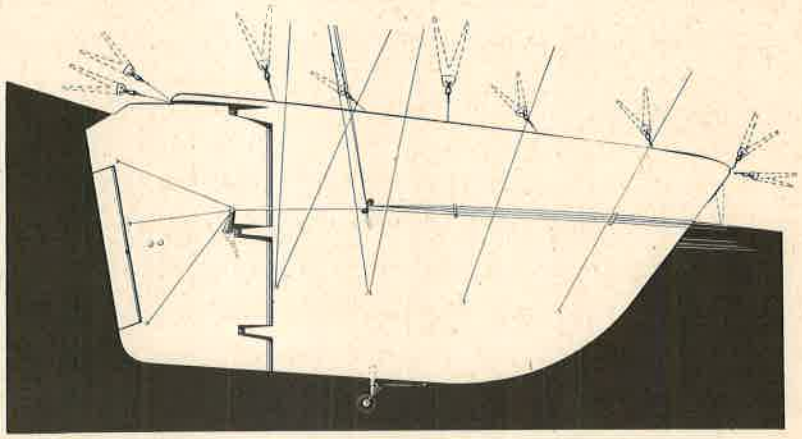


Fig XXIII
LOWER VERTICAL FIN
(Viewed from Starboard)

The hinges for the movable surfaces are aluminum alloy castings with ball bearing inserts. Each surface has three hinges.

A steel fitting with a rubber "stop" is located on the trailing edge of each fin near the base. This stop is so positioned that the elevators strike the rubber "stop" at a 30-degree swing from neutral and the rudders at a 35-degree swing.

The starboard elevator is equipped with an indicator G.E. Type 8DJ-11-PAH (Dwg. 3091-73) which records, on the instrument panel, the up or down position of the elevators.

Each of the two rudders is equipped with a servo-tab in the trailing edge (Dwg. 6091-5) actuated by a bell crank and rod connected to a fitting on the fin structure. This fitting has five holes so that the Servo-tab may be manually and locally adjusted to a counter angle ranging from 0 to 31-1/2-degrees when the rudder is turned to either side 35-degrees.

F. TAIL WHEEL

The swiveling tail wheel (Dwg. 6091-412 for M-1; 6091-441 for M-2, M-3 and M-4), equipped with a 10 x 3 Goodyear smooth contour type tire, is mounted on the lower vertical fin at transverse frame 2. An elastic cord type of shock absorbing device is incorporated in the tail wheel assembly. A coil spring centering device is employed to position the wheel in a fore-and-aft alignment when not under load.

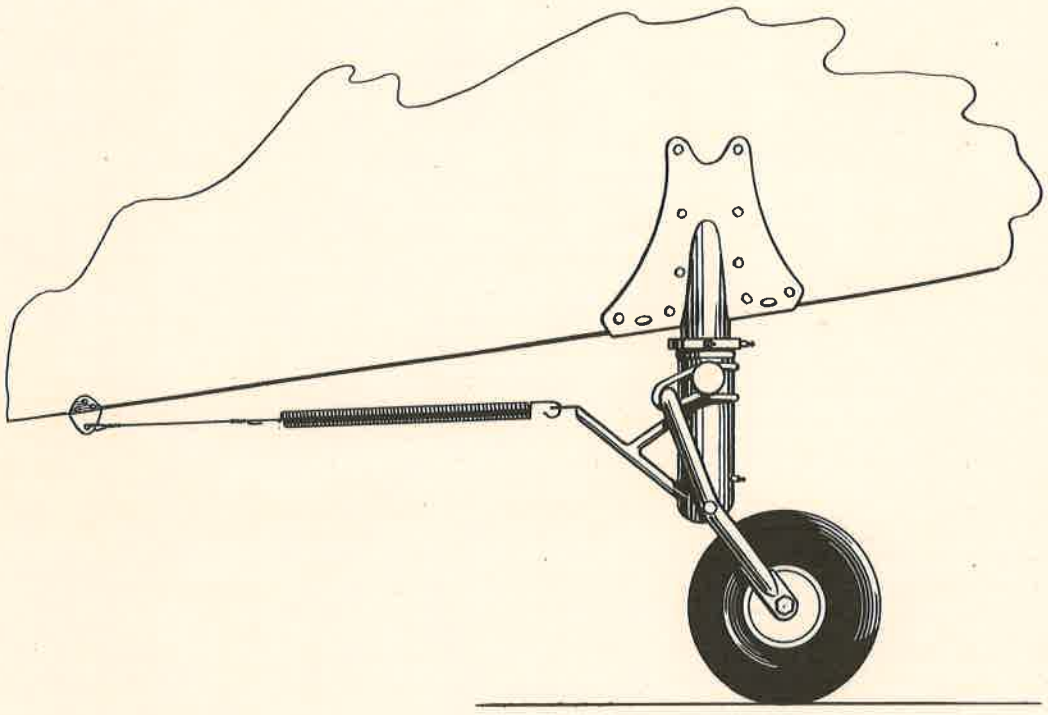
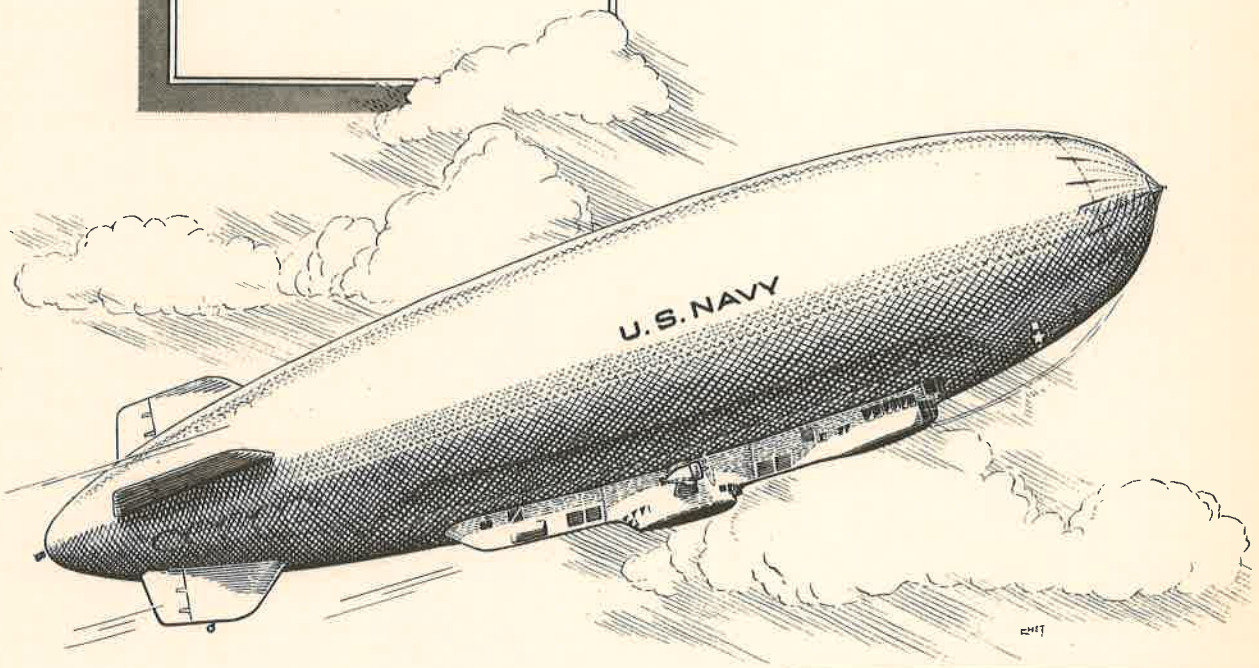


FIG. XXIV - TAIL WHEEL

Part IV

The Control Car



Goodyear "M" Airship

- THE CONTROL CAR -

A. GENERAL DESCRIPTION

The streamlined control car is composed of three distinct units connected by universal joints and faired together. The units in general conform to a V-shaped cross section, enlarged at the forward unit to a U-shaped cross section. A U-shaped keel blister is appended underneath the middle section and an outrigger on each side of this section supports an air-cooled radial engine.

The car is approximately 117-feet 5-inches long, 10-feet wide (exclusive of outriggers) and 20-feet high (including landing wheel).

Construction of the car and outriggers is of welded steel tubing covered on the exterior with doped cotton fabric and sheet aluminum alloy. Contoured, transparent plastic windows are provided entirely around the forward end of the car, around the forward and after ends of the blister, and elsewhere as needed. Entrance doors are located in the forward section and in the bottom of the keel blister. Rescue doors are located at the extreme after end of the car.

A retractable, castering landing wheel is installed in the keel blister, and a similar but smaller wheel near the bottom forward end of the car.

The car is attached to and suspended from the envelope by means of the inside and outside cable suspension systems. (See previous description under "Suspension Systems"). A fabric fairing provides a streamlined junction between the envelope and car.

B. GENERAL ARRANGEMENT

1. Forward Car

The forward section of the car contains the pilot, co-pilot, bombardier, navigator, and radio operator, with all necessary instruments, controls and accessories for the operation of the airship. (Dwg. 6090-3) Fig. XXVI and Fig. XXVII.

The bombardier's compartment is located in the extreme forward section of the car, above and slightly ahead of the pilot's compartment on the car centerline. The pilot's compartment is located between frames 27 and 28, and extends the full width of the car. The space between frames 26 and 27 is left unobstructed for use by the airship commander.

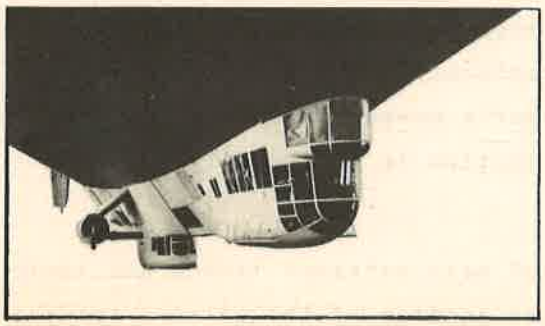


FIG. XXV - VIEW OF CAR

The navigator's compartment is located between frames 25 and 26, on the port side. The radio compartment is across the passage way from the navigator's sta-

tion, and extends forward from frame 24 on the starboard side.

Four bunks, two on each side of the ship, one above the other, are located between frames 22 and 24. Two lockers are installed, one on each side of the ship, between the after end of the bunks and frame 22.

The forward bomb bay, located below the deck level between frames 22 and 25, provides space for four depth charges.

The forward gas valve is positioned in the car roof structure on the starboard side between frames 20 and 21. Louvers for discharged gas are installed in both the port and starboard sides at this point.

Two water ballast tanks are provided in the roof structure between frames 21 and 22. Three 125-gallon fuel tanks are located on each side of the ship between frames 17 and 20.

The galley stove and equipment is located between frames 21 and 22.

2. Middle Car

The mechanic, gunner, M.A.D. and Radar operator, and observer, with all necessary instruments, controls, and accessories for the operation of their equipment, are housed in the car mid-section and keel blister (Dwg. 6090-2) Fig. XXVIII and Fig. XXIX. Two fuel service and two oil storage tanks are located in this section.

The outriggers supporting the main power plant (Two Pratt & Whitney Wasp 550 H.P. engines) are mounted on the main mid-section car structure, on the port and starboard sides, respectively, at frames 12 and 13.

Doors, hinged at the bottom, swing outward and down from the car to form a catwalk to the power plants. They are installed between frames 13 & 14.

The mechanic's station is on the port side of the center section between frames 12 and 13. The mechanic's instrument panel and engine controls are mounted on the after side of frame 13. The operator of the Radar and M.A.D. units and his radio detection apparatus are located on the port side between frames 11 and 12. Directly beneath his compartment, in the blister, is located the Radar beehive unit. The machine gunner's compartment is in the extreme forward end of the blister. The observer's station is in the after portion of the blister, aft of frame 11.

The main retractable landing wheel and main entrance ladder and their retraction mechanism, are housed in the center section of the blister between frames 12 and 14.

NOMENCLATURE - CAR ASSEMBLY - FORWARD SECTION

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1.	Assembly - Car Structure	36.	Electrical Conduit Assembly - Forward Car
2.	Skin Assembly - Forward Frame #27	37.	Galley Storage Shelf
3.	Minor Controls	38.	Galley Stove
4.	Skin Assembly - Aft Frame #27	39.	Heating System Assembly
5.	Installation - 20" Dia. Valves & Air System	40.	Bombardier's Ladder Installation
6.	Installation - Pyrotechnic Pistol Bracket and Shell Cases	41.	Bombardier's Compartment Installation
		42.	Sliding Door - Frame #26
7.	Vent System	43.	Partition at Frame #26
8.	Tank Suspension	44.	Galley Table Assembly
9.	Major Control Installation - Aft Fr. #26	45.	Radio Table Assembly
10.	Wiring Diagram - Forward Car	46.	Locker and Transponder
11.	Fuel System	47.	Locker Installation - Forward Frame #22
12.	Floor Installation Assembly	48.	Hand Rail Assembly
13.	Bunk Assembly	49.	Swinging Door - Frame #21
14.	Table - Navigator - Frames #25 and #26	50.	Installation - Rudder Pilot's Panel
15.	Forward Landing Wheel	51.	
16.	Skin Assembly - Below Floor	52.	Installation - Handling Line Holders
17.		53.	Throttle Interlock
18.	Major Controls - Fwd.Fr.#26 - Elevator	54.	Sink Drain
19.	Major Controls - Fwd.Fr.#26 - Rudder	55.	Installation - Navigator's Altimeter
20.	Installation - Flight Instrument Panel	56.	Installation - Bombardier's Foot Rest and Heel Guard
21.			
22.	ABK Installation - IFF System	57.	Installation - Fire Extinguisher - Aft
23.	Pilot's Instrument Panel	58.	Installation - Fire Extinguisher - Between Frames #25 and #27
24.	Pressure Tube System Assembly		
25.	Installation - Remote Compass	59.	Installation - Gas Chamber
26.	Inclinometer Installation	60.	10° Drift Sight Assembly
27.	Interphone System Assembly	61.	Elevator Pilot's Chair
28.	Stool Assembly	62.	Flashlight - 3 Cell
29.	Navigator's Gear Rack Assembly	63.	Spotlight Installation - Frame #28
30.	Radio Installation	64.	Ceiling & Partitions - Fr.#26 and Fwd.
31.	Chair	65.	Ceiling & Partitions - Fr.#21 to Fr.#26
32.	Water Supply Line	66.	Installation - Window Storage - Fr-#26
33.	Forward Car Hydraulic System	67.	Life Jacket Container
34.	Bomb Attachment Assembly - Forward Car	68.	Parachute Rack - Between Fr. #26 & #27.
35.	Repeater Tube Installation	69.	Light Signal - Grimes Model K-3 28-volt
		70.	

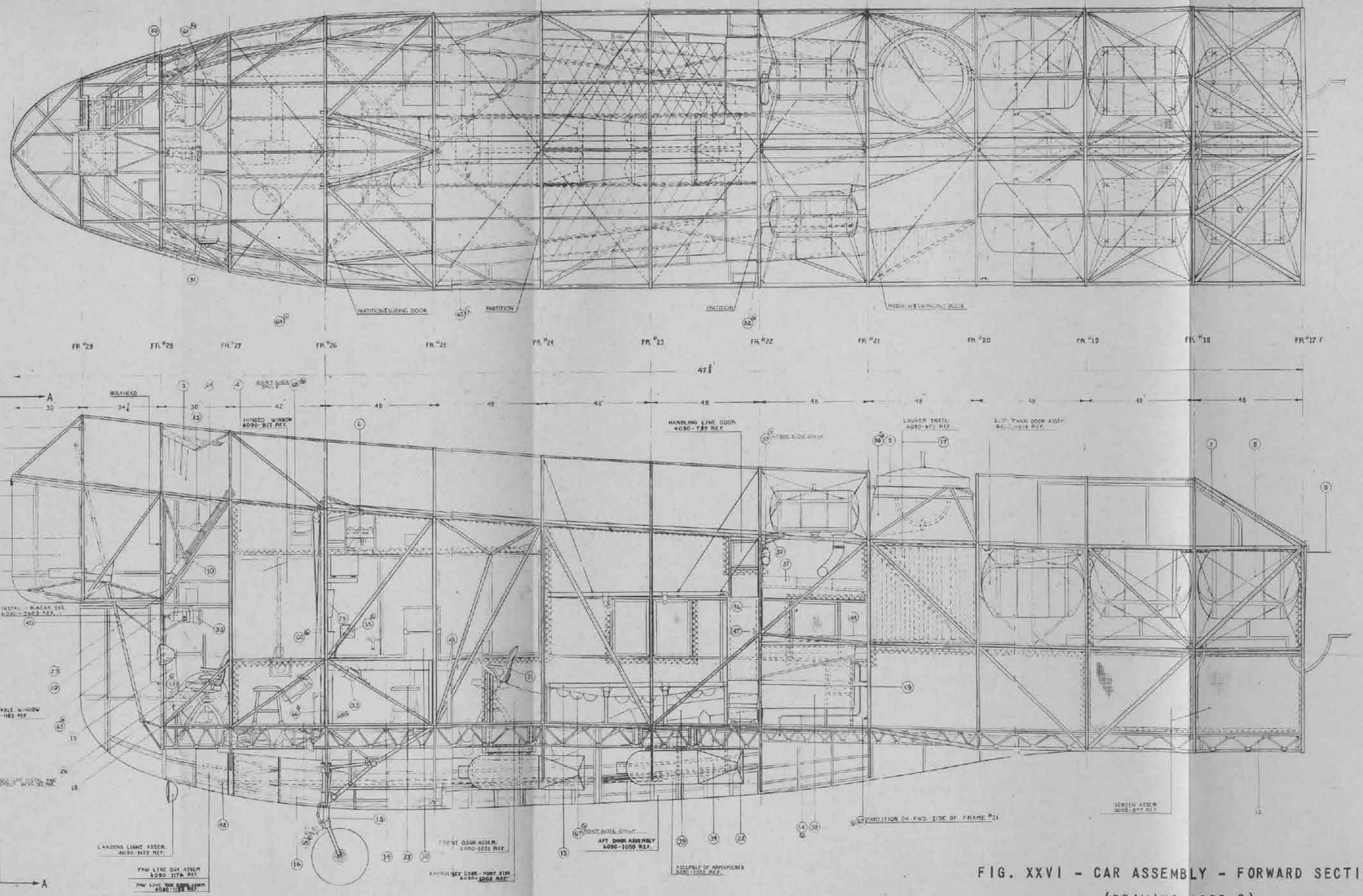
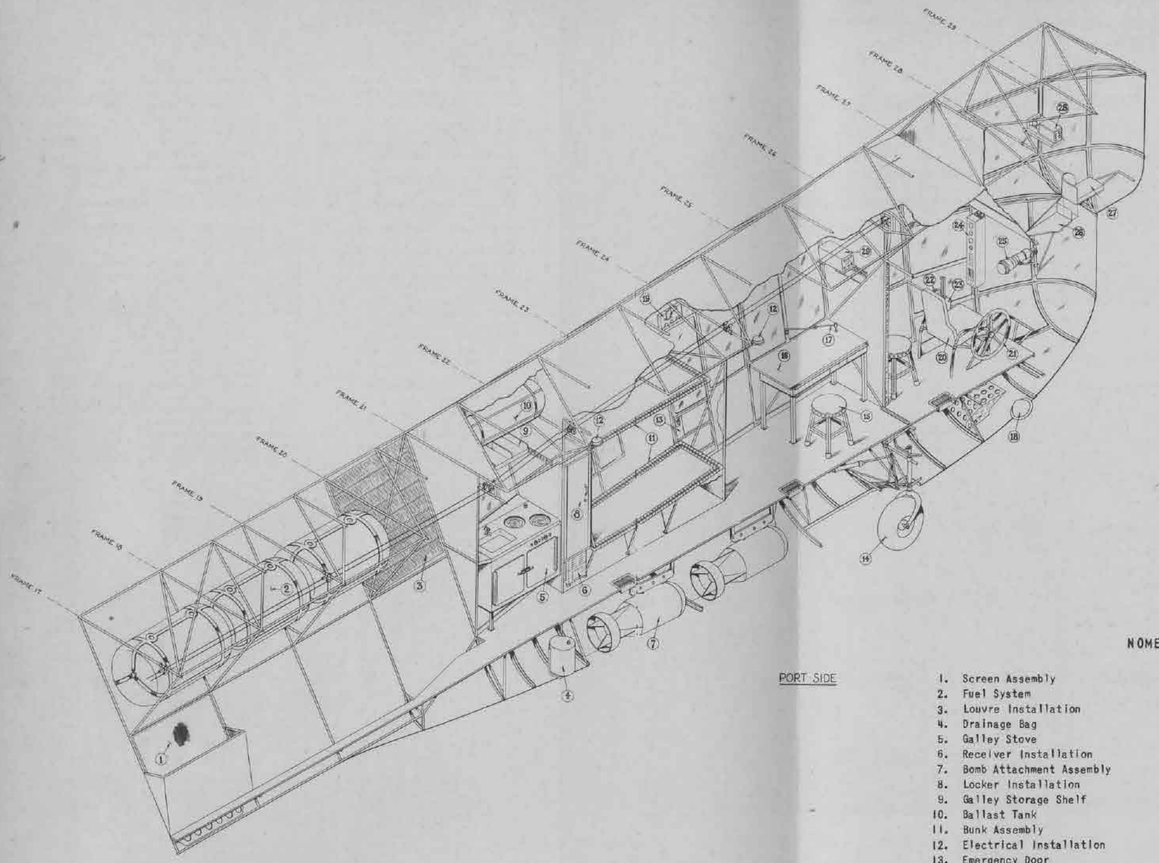
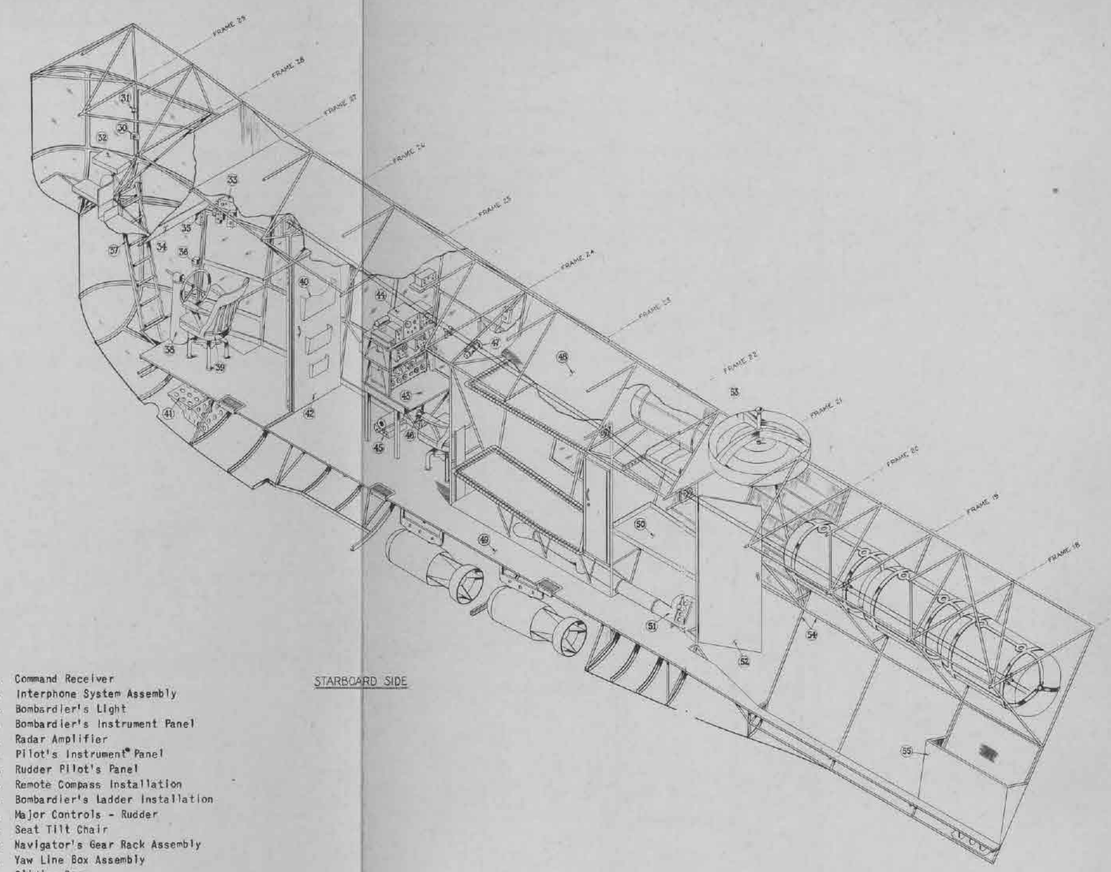


FIG. XXVI - CAR ASSEMBLY - FORWARD SECTION
(DRAWING 6090-3)



PORT SIDE

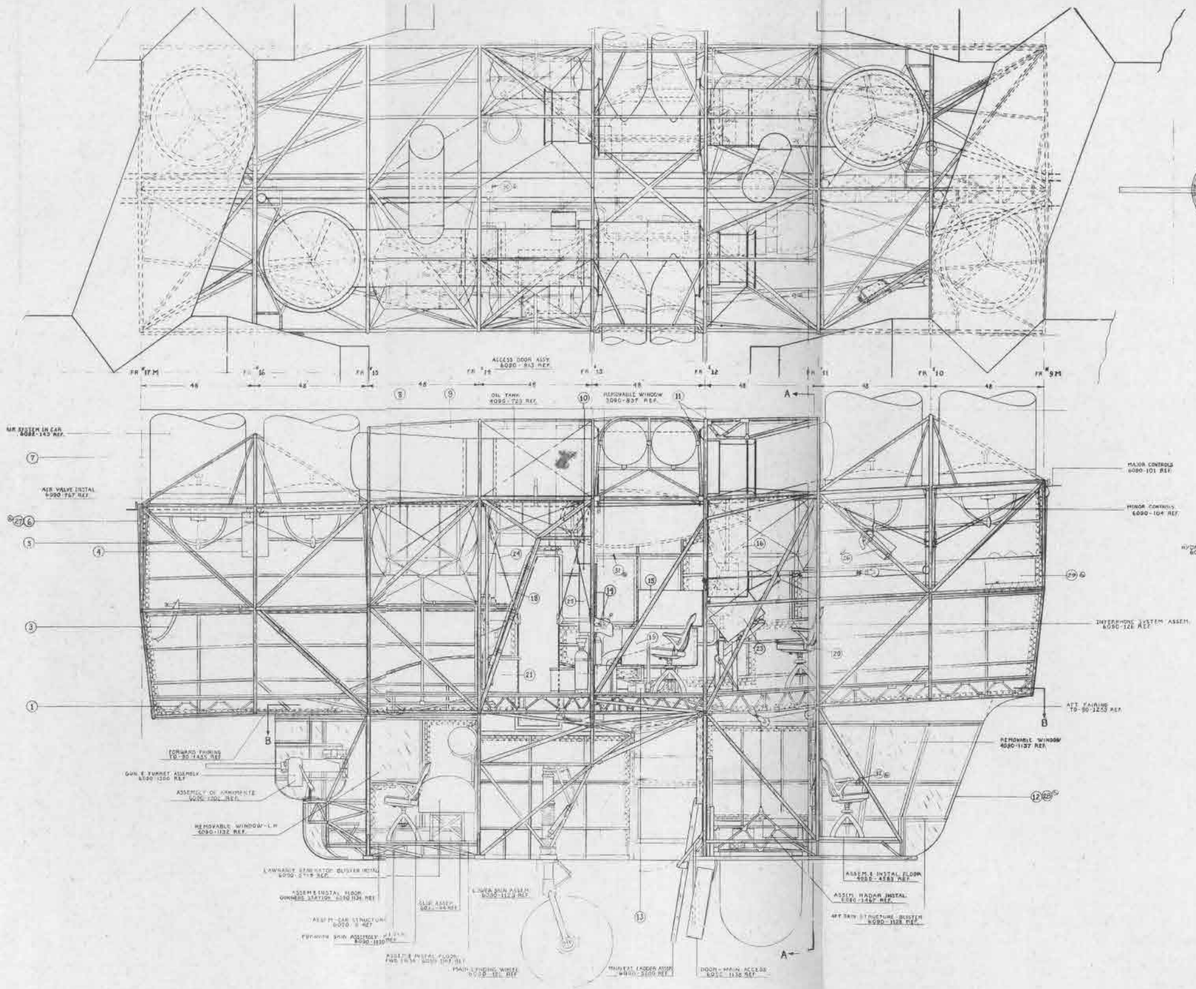


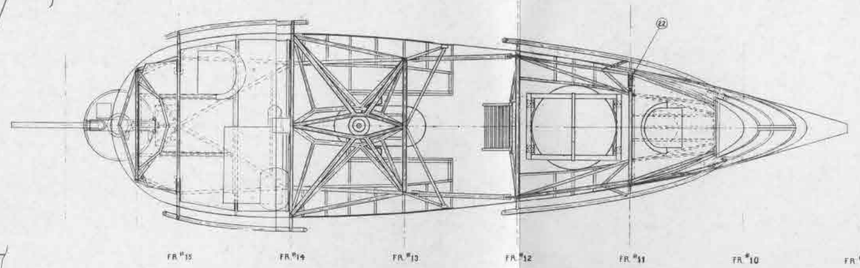
STARBOARD SIDE

NOMENCLATURE

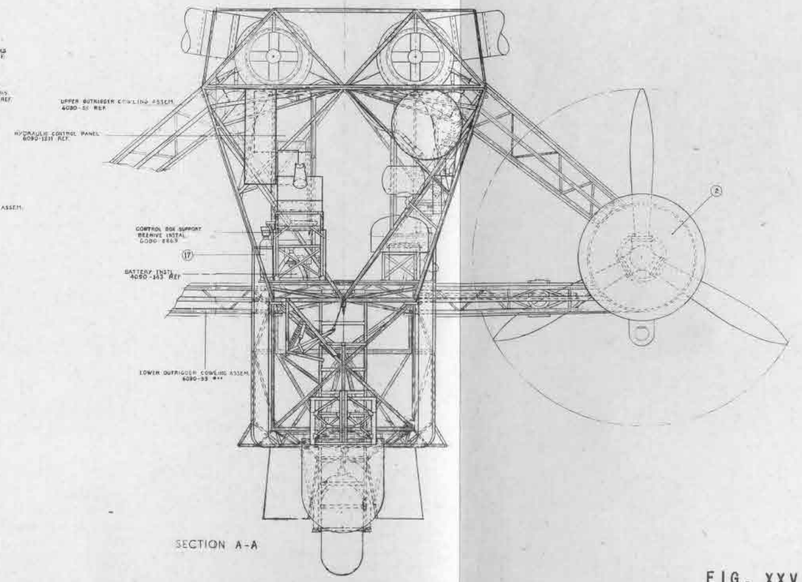
1. Screen Assembly
2. Fuel System
3. Louvre Installation
4. Drainage Bag
5. Galley Stove
6. Receiver Installation
7. Bomb Attachment Assembly
8. Locker Installation
9. Galley Storage Shelf
10. Ballast Tank
11. Bunk Assembly
12. Electrical Installation
13. Emergency Door
14. Forward Landing Wheel
15. Stool Assembly
16. Navigator's Table
17. Navigator's Light
18. Landing Light Assembly
19. Pyrotechnic Pistol Installation
20. Reclining Chair
21. Major Controls - Elevator
22. Inclinometer Installation
23. Engine Controls
24. Flight Instrument Panel
25. Repeater Tube Installation
26. Platform and Map Box
27. Bombardier's Chair Assembly
28. ZBX Radio Receiver
29. Command Receiver
30. Interphone System Assembly
31. Bombardier's Light
32. Bombardier's Instrument Panel
33. Radar Amplifier
34. Pilot's Instrument Panel
35. Rudder Pilot's Panel
36. Remote Compass Installation
37. Bombardier's Ladder Installation
38. Major Controls - Rudder
39. Seat Tilt Chair
40. Navigator's Gear Rack Assembly
41. Yaw Line Box Assembly
42. Sliding Door
43. Radio Table Assembly
44. Radio Installation
45. Dynamotor Installation
46. Antenna Reel and Loading Coil Installation
47. Fire Extinguisher Installation
48. Ceiling Assembly
49. Floor Layout
50. Galley Table
51. Heating System Assembly
52. Swinging Door
53. 36" Dia. Valve & Air System
54. Car Structure
55. Cover - Air Damper Forward Car

FIG. XXVII - SPLIT VIEW -
FORWARD SECTION





SECTION - B-B

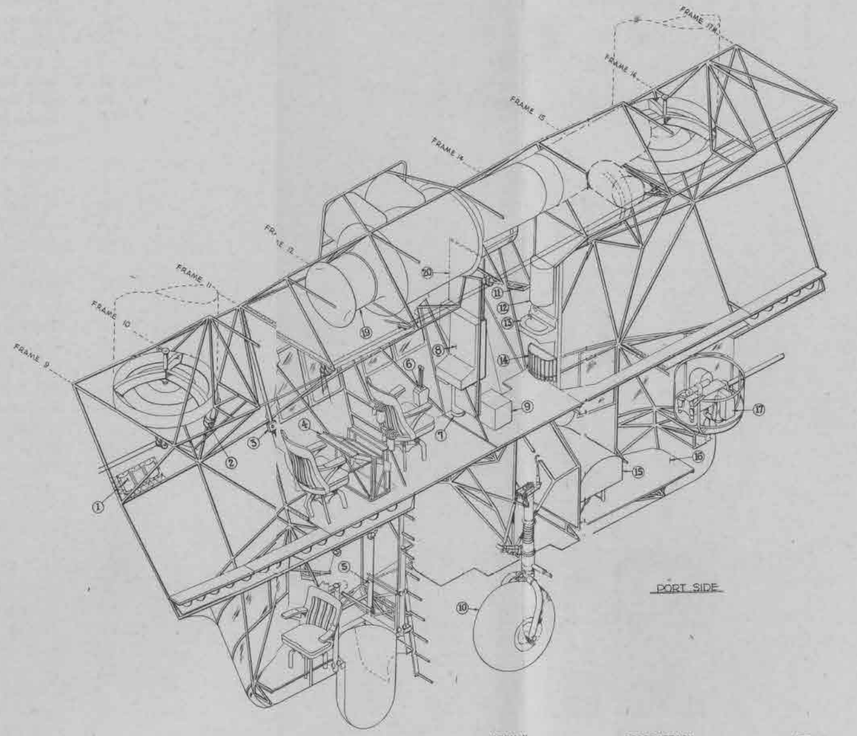


SECTION A-A

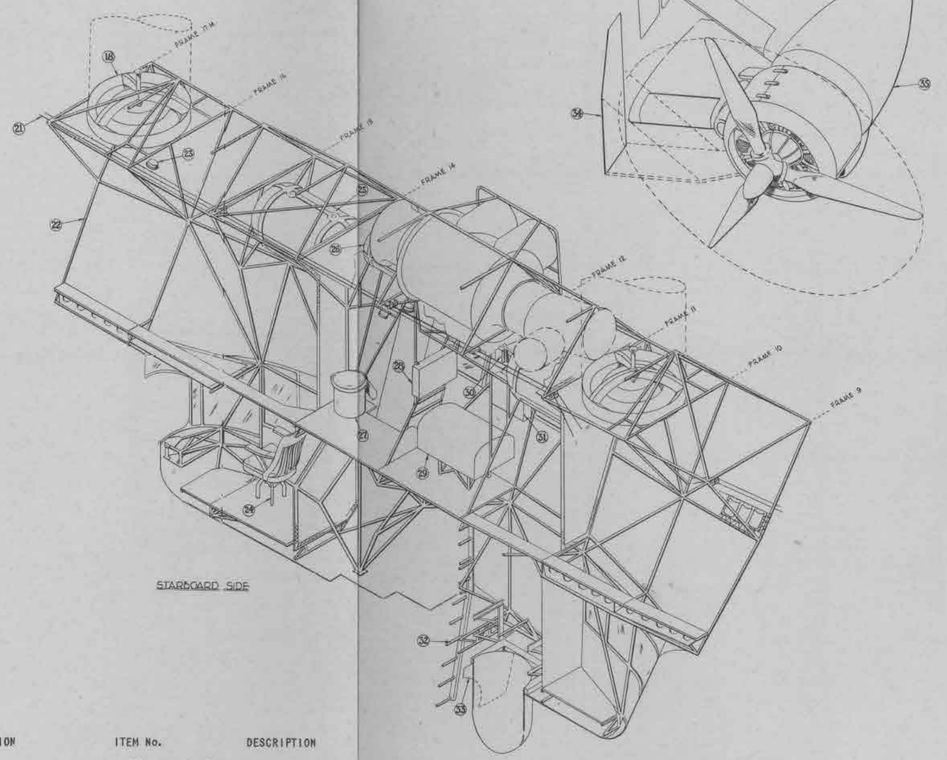
NOMENCLATURE

ITEM NO.	DESCRIPTION
1.	Floor Panel Installation
2.	General Outrigger Assembly
3.	Fuel System
4.	Electrical Conduit Assembly
5.	Skin Assembly
6.	Assembly - Car Structure
7.	Installation - 36" Dia. Valves and Air System
8.	Tank Suspension
9.	Vent System
10.	Installation - Mechanic's Panel Main Junction Box
11.	Support and Installation - Air Intake System
12.	Blister Installation
13.	Hydraulic System
14.	Engine Controls - Car Installation and Assembly
15.	Electric Power Plant Conduit System
16.	Installation - M.A.D. System
17.	Pressure and Fire Extinguisher - Lines
18.	Oil System Assembly
19.	Lawrance Generator Car Installation
20.	Chair
21.	Sanitary Equipment
22.	Installation - Pyramid Matting Observer's Ladder
23.	Installation - Radar System
24.	Suspension Cables for Access Door
25.	Wiring Diagram - Mid Car
26.	Installation - Fire Extinguisher
27.	Assembly Car Structure
28.	Blister Installation
29.	Life Jacket Container
30.	Ceiling, Partitions and Floor Panel - Frame #11 to #14
31.	Installation - Window Storage Aft of Frame #13
32.	Installation - Window Storage Blister - Aft Frame #11

FIG. XXVIII - CAR ASSEMBLY - MID SECTION AND KEEL BLISTER (DRAWING 6090-2)



PORT SIDE



STARBOARD SIDE

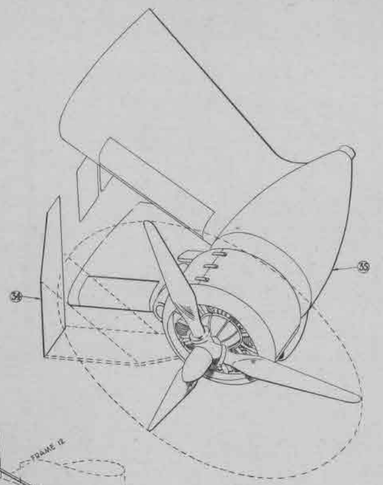
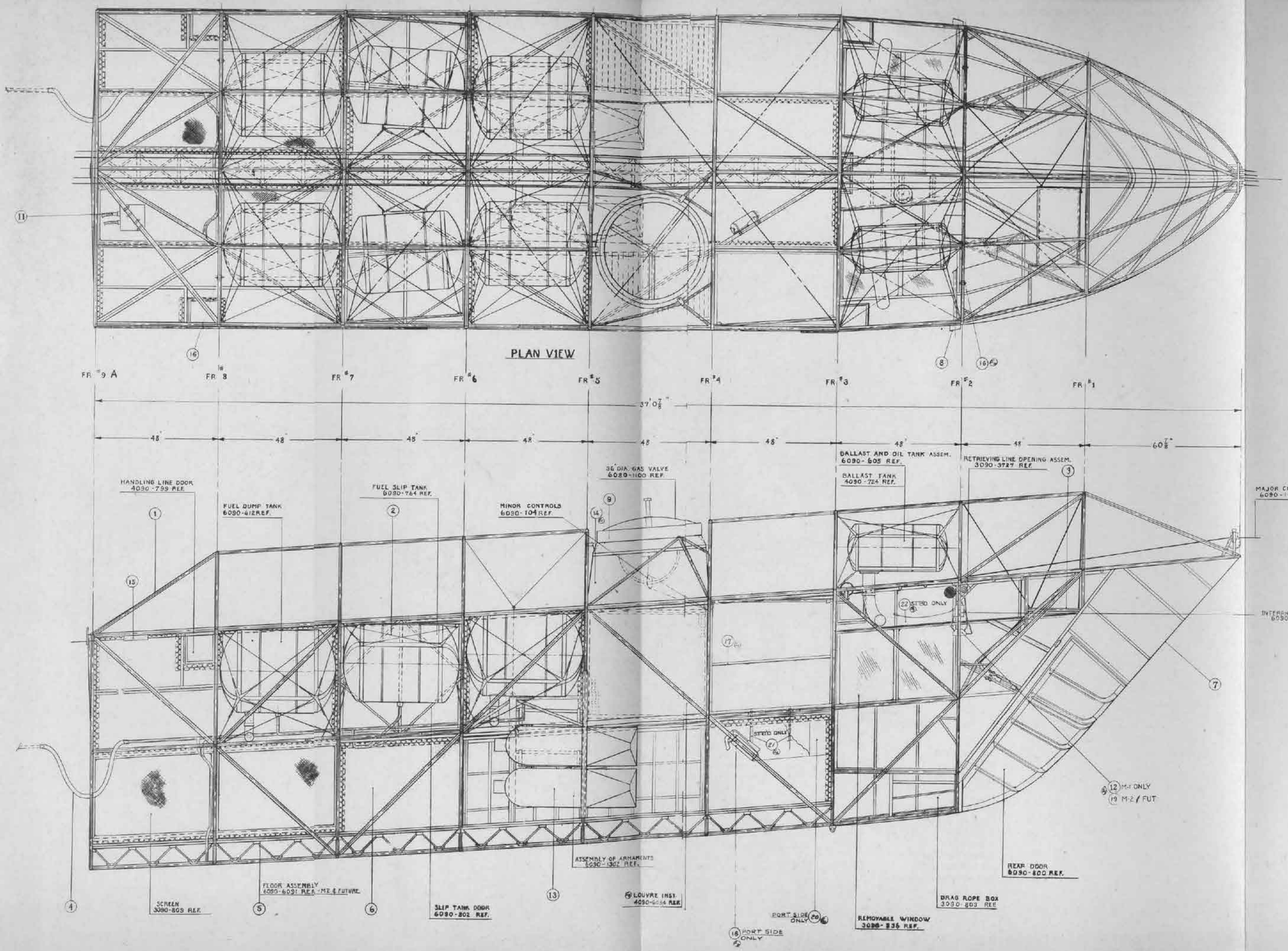


FIG. XXIX - SPLIT VIEW -
MID SECTION AND KEEL BLISTER

NOMENCLATURE

ITEM No.	DESCRIPTION
1.	Life Jacket Container
2.	Fire Extinguisher
3.	Interphone System
4.	Radar System
5.	Assembly Radar Installation
6.	Engine Controls
7.	Fire Extinguisher
8.	Mechanic's Panel - Main Junction Box
9.	Battery Installation
10.	Main Landing Wheel
11.	Towel Holder
12.	Water Tank
13.	Wash Stand
14.	Soiled Towel Rack
15.	Lawrance Generator - Blister
16.	Gunner's Station
17.	Gun and Turret Assembly
18.	Air Valve Installation
19.	Air System - In Car
20.	Hydraulic Control Panel
21.	Major Controls
22.	Assembly Car Structure
23.	Dome Light
24.	Chair
25.	Fuel System
26.	Oil Tank
27.	Chemical Closet
28.	Breaker Panel
29.	Lawrance Generator - Car
30.	Voltage Regulator
31.	Installation Panel - Electrical Power
32.	Main Extension Ladder
33.	Main Access Door
34.	Access Door
35.	General Outrigger



NOMENCLATURE

ITEM NO.	DESCRIPTION
1.	Assembly Car Structure
2.	Tank Suspension Assembly
3.	Observation Platform
4.	Fuel System
5.	Floor Assembly
6.	Skin Assembly - Frames #3 to #9
7.	Skin Assembly - Aft of Frame #3
8.	Vent System
9.	Installation - 36" Dia. Valves & Air System
10.	
11.	Aft Car Conduit Installation
12.	Hydraulic System
13.	Bomb Attachment Assembly - Aft
14.	Installation - Gas Chamber - Aft Car
15.	Wiring Diagram - Aft Car
16.	Installation - Handling Line Holders
17.	Installation - Window Storage Between Fr. #3 and #4
18.	Installation - Fire Extinguisher - Between Frames #3 and #4
19.	Aft Car Hydraulics
20.	Life Jacket Container
21.	Life Raft Support
22.	Parachute Pack
23.	Installation - Safety Bar Frame #2

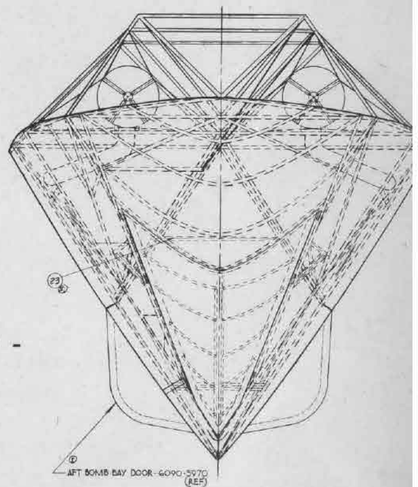
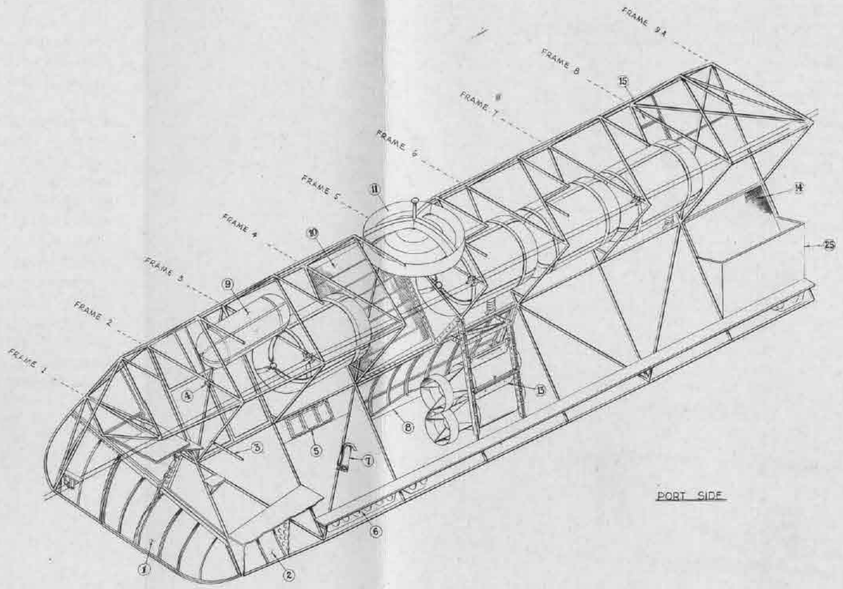
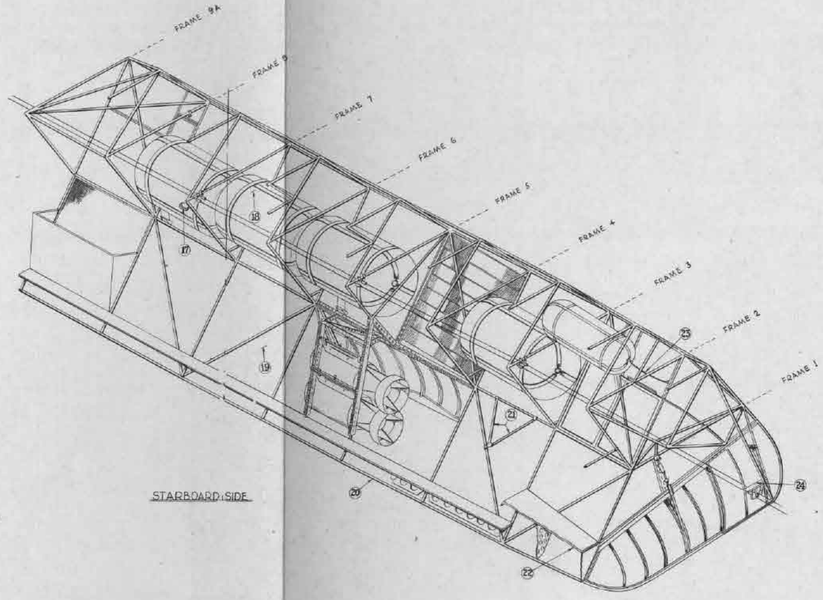


FIG. XXX - CAR ASSEMBLY - AFTER SECTION (DRAWING 6090-1)



PORT SIDE



STARBOARD SIDE

FIG. XXXI - SPLIT VIEW - AFTER SECTION

NOMENCLATURE

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1.	Rear Door	13.	Floor Assembly
2.	Drag Rope Box	14.	Screen Assembly
3.	Safety Bar	15.	Handling Line Door
4.	Interphone System Assembly	16.	Installation of Handling Line Holders
5.	Life Jacket Installation	17.	Electrical Installation
6.	Floor Assembly	18.	Fuel System
7.	Fire Extinguisher	19.	Slip Tank Door
8.	Aft Bomb Bay Door	20.	Car Structure Assembly
9.	Ballast and Oil Tank Assembly	21.	Life Raft Supports
10.	Louvre Installation	22.	Floor Assembly
11.	36" Diameter Valve	23.	Parachute Pack Installation
12.	Bomb Attachment Assembly	24.	Support - Major Control
		25.	Air Damper Cover

The 36-inch air valves for the forward ballonet and the center ballonet system are located in the car roof structure between frames 16 and 17, and frames 15 and 16, respectively. The 36-inch air valves for the after ballonet and the center ballonet system are located in the roof of the car structure between frames 9 and 10, and frames 10 and 11, respectively. Two auxiliary blowers for the air system are located in the car roof structure, one on the port side between frames 11 and 12, and one on the starboard side between frames 13 and 14.

Two Lawrence generators are installed to provide power for the ship's electrical system. One of these generator units is installed on the starboard side of the mid-section between frames 12 and 13, while the other unit is installed in the blister on the port side just forward of frame 14.

The sanitary equipment consisting of a wash basin, towel rack, and toilet, is located between frames 13 and 14.

Two 125-gallon fuel tanks are located in the middle car structure, one between frames 14 and 15 on the port side, and one between frames 11 and 12 on the starboard side. Two 40-gallon oil storage tanks are located between frames 13 and 14, on the port and starboard sides of the car.

3. After Car

The after car section contains additional fuel tanks, water ballast tanks, depth charges, the after gas valve, and the after rescue doors, Fig. XXX and XXXI.

Six 125-gallon fuel tanks are symmetrically located in the car structure on each side of the passage way, three to a side, between frames 5-6, 6-7, and 7-8.

Two 40-gallon water ballast tanks are located in the car roof structure between frames 2 and 3, on the port and starboard sides, respectively.

The 36-inch after gas valve is located in the car roof structure on the port side, between frames 4 and 5, and discharges through a fabric duct leading to louvers on the port and starboard sides.

The after bomb bay, providing space for four depth charges, is located on either side of the catwalk between frames 4 and 6.

C. STRUCTURE

The car structure is composed of a welded chrome molybdenum steel tubular framework built in three sections and articulated by universal joints

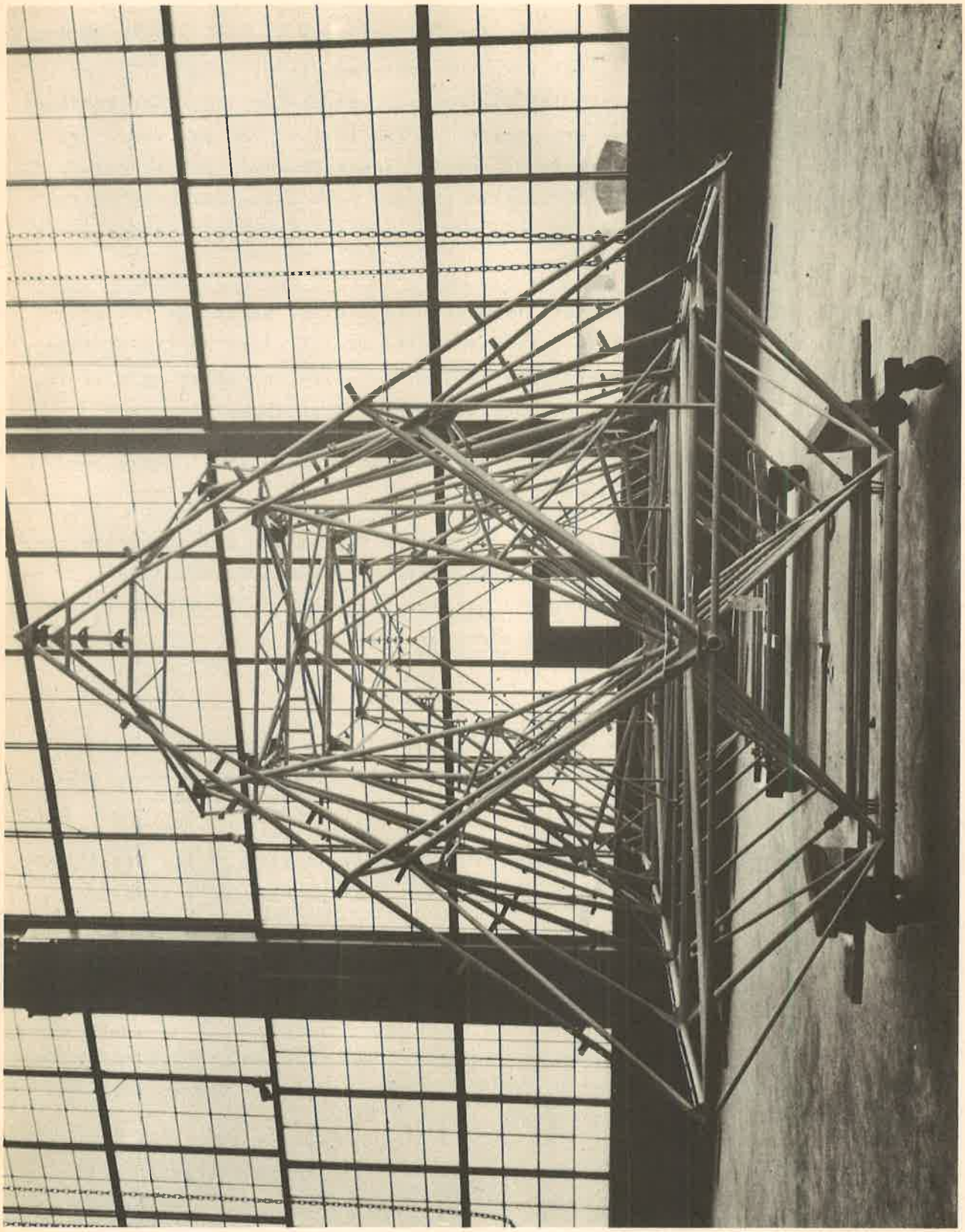


FIG. XXXII - INVERTED MIDDLE CAR STRUCTURE

at frames 9-9M and 17-17M. (Dwgs. 6090-6, -7, -8). It consists of 29 transverse frames, four-foot spacing (except frames 26, 27, 28, and 29, and frame 1) with connecting longerons. For rigidity and strength at critical sections, the longitudinal panels formed by the transverse frames and the longerons are diagonally braced with tubing. The structure is further strengthened by diagonal bracing of high strength aircraft wire (GAC Spec. N0034) wherever necessary.

Special tubular reinforcement is necessary in the mid-section structure, at frames 12 and 13, to handle the stresses introduced by the outrigger, power plant assembly and the landing loads through the main landing wheel.

Suspension fittings for the car internal suspension cables are welded to the transverse frames at the main junction point (ceiling joint) of the upper structural members at frames 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, and 26. (Dwg. 6092-12).

At the upper outermost joints on each transverse frame (port and starboard sides, respectively), except at frames 28 and 29, suspension fittings are welded for attachment of cables from the outside catenary curtain suspension system.

Clips, brackets, and supports for the outer skin, window attachments, door attachments, control brackets, fuel and oil tanks, and other miscellaneous equipment are welded or clamped to the structure.

Before welding the joints of the car structure, the tubes are drilled at the joints so that the entire structure of each section is interconnected to permit oiling of the inside of all tubes after welding is completed.

After assembly of each car section structure, the tubes are sandblasted and receive one coat of zinc chromate and one coat of grey or dark green lacquer as required.

D. COVERING

The car covering consists of doped cotton fabric and aluminum alloy sheet. The car section forward of frame 27 and aft of frame 3, the window framing, and the mid-section around the outriggers and blister are covered with .020-inch 24ST Alclad.

Various angles and channels of 24ST Alclad are riveted to clips welded or clamped to the tubular steel framework of the car. The aluminum alloy skin is attached to these members by aluminum alloy rivets.

The balance of the car, except for windows, screens, louvers and doors,

NOMENCLATURE FOR FIG. XXXIII

ITEM NO.	GRADE	GAUGE INCHES	NO. REQUIRED	GAC DRAWING NO.
1	A	.125	1	4090-4626
2	A	.125	1	4090-4616
3	A	.080	1 port 1 stbd.	6090-52-76
4	A	.125	1 left 1 right	4090-4617
5	A	.060	1 port 1 stbd.	6090-52-5
7	A	.125	1	6090-4620
8	A	.080	1 port 1 stbd.	6090-52-8
9	A	.125	1	4090-4622
10	A	.125	1 left 1 right	4090-4623
11	A	.125	1	4090-4624
12*	A	.080	1 port 1 stbd.	6090-52-114
12A*	A	.125	2 port sliding	2090-2187
12B*	A	.125	2 stbd. sliding	2090-8188
13	A	.125	1 left 1 right	3090-4627
14	B	.060	2 port folding 2 stbd. folding	6090-921-13
15	B	.060	4 port 4 stbd.	6090-49-5
16	B	.060	2 port 2 stbd.	6090-49-4
17*	B	.060	1 port fixed	6090-49-3
17*	A	.080	1 stbd. sliding	3090-8136
18	B	.060	1 port 1 stbd. removable 1 port 1 stbd. fixed	6090-48-13
19	B	.060	2 port 2 stbd.	6090-48-13
20	A	.125	1	2090-5010
21	A	5/32 & 1/4	1	6090-1303
22	A	.080	1 left 1 right	4090-5011
24	A	.080	1 port 1 stbd.	4090-5113
26	B	.060	2 sliding	4090-1132
27	B	.080	1 port 1 stbd.	6090-1128-34
28	A	.080	2 sliding	3090-8104
29	B	.080	1 left 1 right	4090-4567
30	B	.080	1 left 1 right	4090-4568
31	B	.125	1	4090-4591
32	B	.060	1 port 1 stbd. removable 1 port 1 stbd. fixed	4090-836-9
34*	B	.060	2	6090-7432-47

* These items vary in quantity or type on M-1 Airship.

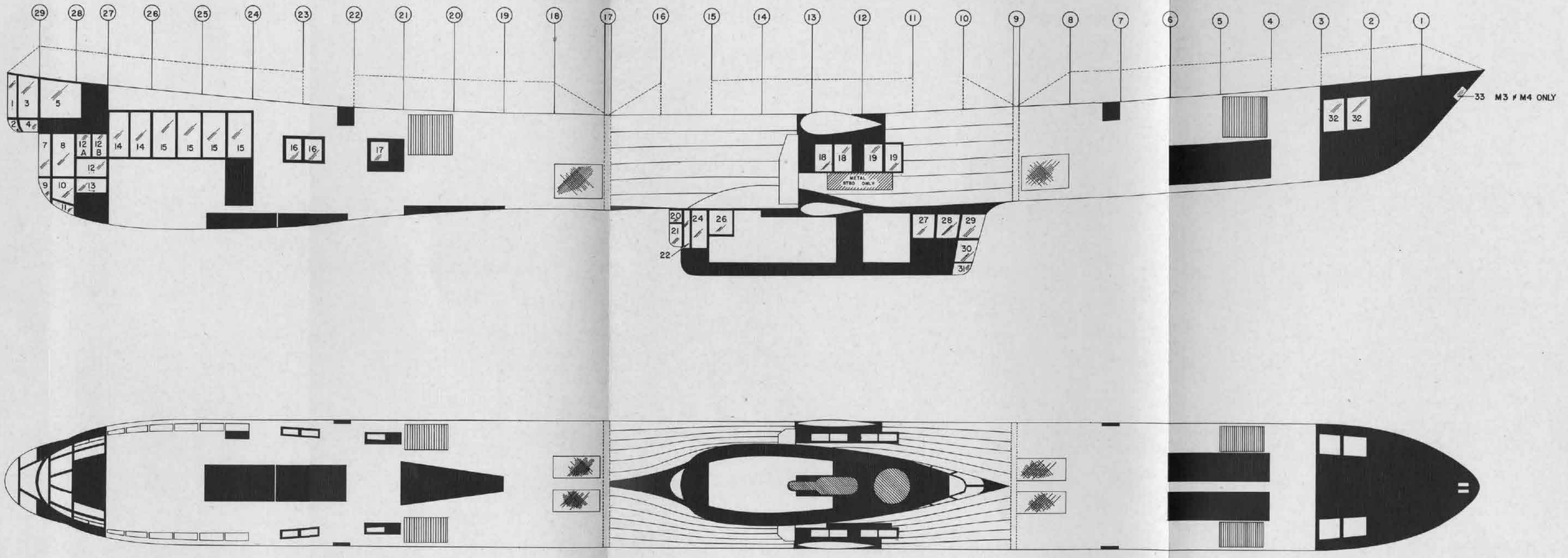

29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
1 3 5
2 4
7 8 12 A 12 B 14 14 15 15 15 15
12
9 10 13
11
16 16
17
18 18 19 19
METAL STBD ONLY
20 21 22 24 26
27 28 29 30 31
32 32
33 M3 ≠ M4 ONLY
N°3 - REMOVABLE PORT ONLY
N°12 - DOUBLE SLIDING
N°14 - DOUBLE FOLDING
N°17 - STBD. SLIDING M2 ≠ FUT.
N°18 - REMOVABLE
N°26 - SLIDING
N°28 - SLIDING
N°32 - REMOVABLE
METAL
SCREEN
PLEXIGLASS
FABRIC
OPENINGS

FIG. XXXIII

WINDOW LOCATION SKETCH

is covered with doped 2.9 oz. BB cotton cloth. The fabric skin is laced in place by #12 cotton cord, and the lacing covered by a fabric sealing strip doped in place.

E. WINDOWS

The car windows are made of transparent plastic, conforming to Navy Spec. P-41. Grade A plastic is used in the bombardier's, pilot's, and gunner's compartments and in part of the observer's compartment. Grade B plastic is used elsewhere.

All windows are contoured to the shape of the car. A complete list of window gages, locations and types is shown on the sketch in Fig. XXXIII.

All fixed, swinging and removable windows are seated in rubber (G.T. & R. Co. K-314 or Armstrong Corprene RK-304) and are held in place by aluminum alloy angles. This method of construction permits the window to expand or contract with temperature and humidity changes.

For the fixed windows these angles are fastened directly to the car structure by "Speed Nuts" and machine screws. The removable and swinging windows are likewise mounted in aluminum alloy angle frames, these frames being held in place by window latch fittings and/or continuous aluminum hinges.

The sliding windows are similarly held in place by aluminum alloy angles. Felt is cemented to the window channels with Dolphinite before installation. For details of installation refer to the respective skin assembly drawing as referenced in Fig. XXXIII.

F. BOMB HATCHES

Two bomb bays are provided, one forward between frames 22 and 25 and one aft between frames 4 and 6. Each bay accomodates four, 325-pound depth charges, located symmetrically about the longitudinal centerline of the car, two bombs to a side. (Dwg. 6090-1, -3 and #6P-1253).

The forward bomb bay has four doors, two on each side of the car centerline. These are hinged and swing outward. The two forward doors of the forward bay are 26-13/32-inches by 67-7/8-inches, while the two after doors of the forward bay are 24-inches by 67-1/2-inches.

The forward bomb bay doors are constructed of aluminum alloy sheet, reinforced with structural aluminum members and shaped to conform to the skin contour of the car. They are hydraulically operated by remote control from the bombardier's compartment. (See Dwg. 6090-1050-1051).

The after bay is equipped with two hinged doors, 44-1/16-inches by

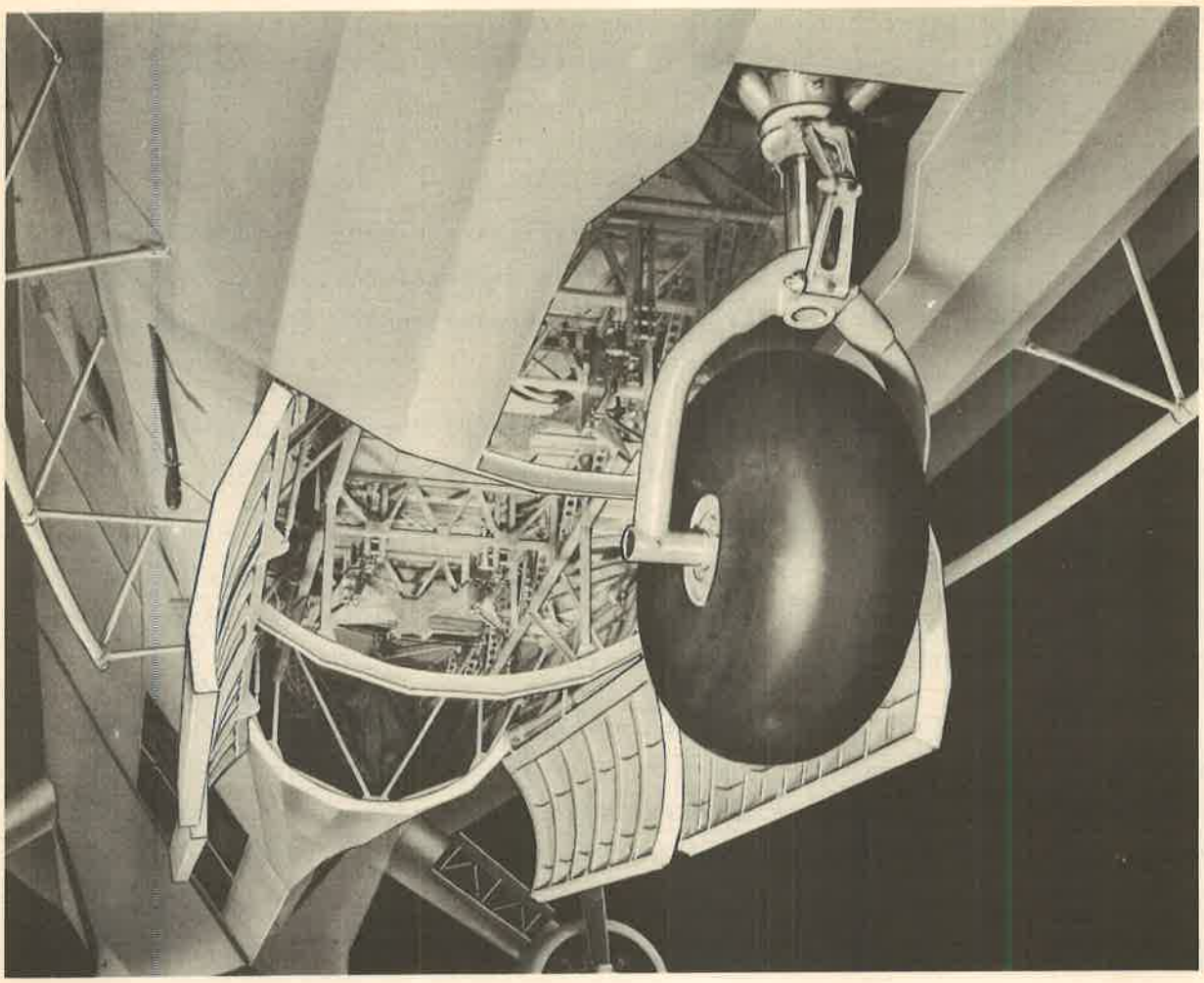


FIG. XXXIV - FORWARD BOMB BAY AND LANDING WHEEL

94-3/8-inches, made of aluminum alloy sheet reinforced with structural aluminum members and streamlined so as to blend in with the contours of the car. The doors swing outward and are controlled hydraulically by remote control from the bombardier's compartment.

G. DOORS AND ACCESS LADDER

1. Access Doors

Four doors are provided to the car. The forward door is located on the port side just aft of the navigator's compartment, between frames 24 and 25. Two after doors are located at the extreme stern, hinged on the port and starboard sides. The main entrance trap door is in the bottom of the mid-car keel blister between frames 12 and 13, and operates in conjunction with a retractable entrance ladder.

The forward port door, 21-1/4-inches wide by 73-7/8-inches high, is hinged at the forward edge and opens out. (Dwg. 6090-1002). The door has an

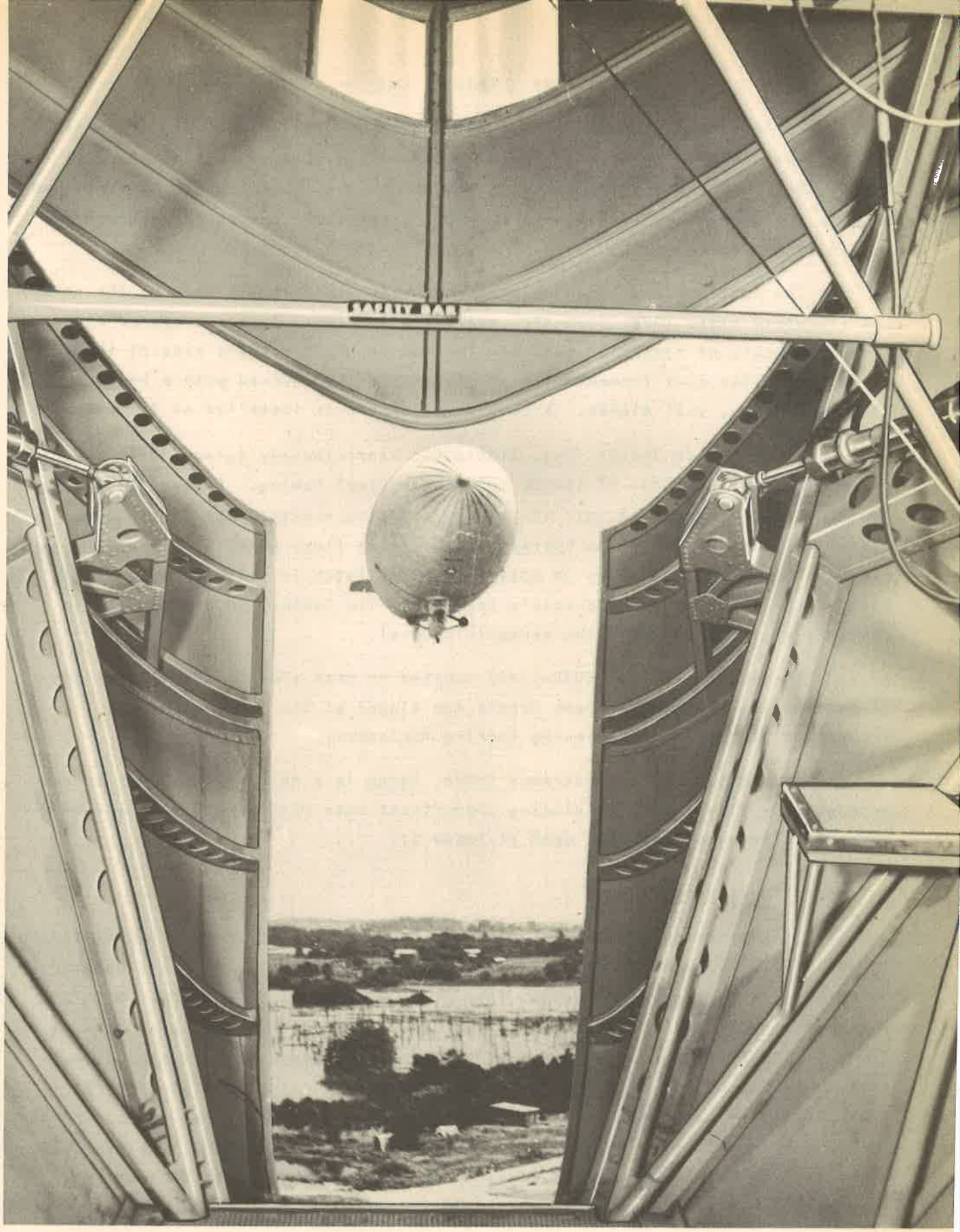


FIG. XXXV - AFTER DOUBLE DOORS

aluminum alloy framework with .032-inch gauge 24ST Alclad skin, and contains a plexiglas window .080-inch gauge. Door handles and latch are installed to fasten the door, and a cord extending forward through the car skin is installed to hold the door open. A hinged safety bar is provided across the doorway as an additional safeguard.

The double doors, located at the extreme stern, are hinged on the port and starboard sides (Dwg. 6090-800) and swing outward. They are opened and closed by means of hydraulic controls located on the starboard side of the car at frame 2. The door framework is of aluminum alloy covered with a skin of .032-inch gauge, 24ST Alclad. A hinged safety bar is installed at frame 2.

The entrance ladder (Dwg. 6090-5200) approximately 8-feet long, is constructed in two sections of chrome molybdenum steel tubing. During flight the lower section is drawn up into the blister and the entrance trap door (Dwg. 6090-1138) linked with it is hydraulically closed flush with the car skin surface and mechanically locked in position. This latch is released by a toggle knob on the floor at the mechanic's position. The ladder and door hydraulic controls are located above the mechanic's panel.

A side panel (Dwg. 6090-1141) located on each side of the blister completes the door opening. These panels are hinged at the forward end and secured in place by quick opening locking fasteners.

In addition to the entrance doors, there is a metal access door to each outrigger, a fabric covered sliding compartment door at frame 26, and a fabric covered swinging compartment door at frame 21.

2. Compartment Doors

The compartment doors are both constructed of 52SO aluminum alloy tubing 1-inch O.D. x .035-inch wall, welded into a rigid assembly. They are covered on both sides with grade HH cotton fabric, sewed and doped in place. Both are equipped with latches for holding in a closed position. The swinging door at frame 21 (Dwg. 4090-912) is suspended by three aluminum hinges riveted to supporting angles on the door and car structure. The sliding door at frame 26 (Dwg. 6090-1252) operates on four wheels running on tracks at the top and bottom of the door opening and is equipped with felt sealing strips to prevent any light from entering the pilot's compartment from the after end of the car. A gear rack for the navigator is secured to the after side of the door.

3. Outrigger Access Doors

Each engine nacelle is accessible by means of an access door, located one on the port and one on the starboard sides of the car between frames 13

and 14, just forward of the engine outriggers (Dwg. 6090-913). The doors are hinged at the bottom and in normal flight are retracted flush with the sides of the car. In opening the doors swing outward and downward to a horizontal position and serve as a catwalk to the engines. In the open position the outer ends of the doors are supported by cables from within the car.

H. HANDLING LINE AND DRAG ROPE BOXES

The yaw line boxes (Dwg. 6090-1176) are located on the port and starboard sides respectively, in the forward car forward of frame 27.

The drag rope box (Dwg. 6090-803) is located on the bottom port side of the after car between frames 2 and 3.

The yaw line boxes, as well as the drag rope box, are equipped with hinged metal doors and quick-release catches which are operated by remote control from the pilot's compartment. The doors of all boxes are flush with and conform to the outside contour of the car. The box doors and hinges are so positioned that the yaw lines and drag rope drop out when the doors are opened.

The car handling line doors (Dwg. 4090-799) Fig. XVIII are located on the port and starboard sides at ceiling level aft of frame 3, forward of frame 8, and forward of frame 22. Release catches on the car handling line doors are locally operated.

Openings for the anti-roll retrieving lines are located aft of frame 2, on the port and starboard sides respectively, at ceiling level. (Dwg. 3090-3727).

The retrieving line for the bow pendant leads through an opening in the upper forward section of the bombardier's compartment in the extreme front of the forward car.

I. HANDRAILS

Handrails are installed at the forward end of the car on each side from frame 23 to frame 27 (Dwg. 6090-1254) and on each side of the mid-car keel blister from frame 10 to frame 12 (Dwg. 6090-1461) and frame 14 to frame 15.

The handrails are 1-3/4-inches O.D. x .065-inch wall 24ST aluminum alloy tubing attached to 3/4-inch O.D. x .035-inch wall chrome-moly steel tubing stand off brackets on the lower part of the car structure.

J. FLOORING

The car flooring extends the entire length of the car sections in the

form of a catwalk except above the blister and in the forward section where it widens to cover the entire width of the car. Sections are as follows:

		GAC Drawing No.
From frame 2 to frame 3	(Full car width raised platform 12" above floor)	5090-113 M-1 only 6090-6091 M-2 & Fut.
From frame 3 to frame 11	(11-inches wide)	5090-113 M-1 only 6090-6091 M-2 & Fut.
From frame 11 to frame 12	(Half car width Port side)	6090-114 M-1 only 6090-6092 M-2 & Fut.
From frame 12 to frame 14	(Full car width)	6090-114 M-1 only 6090-6092 M-2 & Fut.
From frame 14 to frame 17	(11-inches wide)	6090-114 M-1 only 6090-6092 M-2 & Fut.
From frame 17 to frame 20	(9-inches wide)	6090-115
From frame 20 to frame 22	(Full car width)	6090-115
From frame 22 to frame 24	(30-inches wide)	6090-115
From frame 24 to frame 28	(Full car width)	6090-115
From frame 14 to frame 15	(Fwd. blister Full car width)	6090-1147 6090-1136
From frame 10 to frame 11	(Aft blister Full car width)	4090-4593

In addition to the regular flooring, two raised steps and an observation platform (Dwgs. 3090-696, 3090-658, and 4090-660) are provided in the after end of the car for access to the external suspension cable adjustments and the after, envelope manhole.

The flooring is balsa filler with aluminum "pyramid" deck plate on the top side and .020-inch 24ST Alclad on the bottom side, having a total thickness of approximately 3/4-inch. The balsa filler is reinforced by a spruce or hemlock frame on the outside edges of all floor panels. Alclad scuffing strips are installed around the floor edges on the car sides from frames 24 to 27.

Longitudinal trussed girders of aluminum alloy construction extend from frame 3 to frame 28 to support the flooring in conjunction with the transverse frame structure. These trusses are of built-up channel construction and vary in height from 7-1/2-inches to 12-inches. From frame 3 to frame 20, except the floor area between frame 11 to frame 14, the floor structural member is a

single built-up girder catwalk (Dwgs. 6090-113, -114, -115). From frame 11 to frame 14 and from frame 20 to frame 28 the single built-up girder fans out into a system of longitudinal girders to provide the main control car floor structure. Openings and removable panels are provided in the floor as required. All panels may be removed if necessary, but only certain center panels are easily removed or opened for normal service requirements. They are as follows:

	Location	Purpose
1.	Frame 12 and 13	For access to blister and trap door exit
2.	Frame 13 and 14	For access to main landing wheel
3.	Frame 22 and 23	For access to forward bomb bay
4.	Frame 23 and 24	For access to forward bomb bay
5.	Frame 24 and 25	For access to fwd, bomb bay and heater duct
6.	Frame 25 and 26	For access to forward landing wheel
7.	Frame 27 and 28	For access to landing light & yaw-line boxes.

The catwalk between frames 14 and 16 is hinged at its after end to provide unrestricted vertical clearance for the machine gun in the blister.

K. CEILING AND PARTITIONS

A fabric ceiling of HH cotton cloth Spec. 27C13 is installed at ceiling level from frame 11 to frame 14 over the mechanic's compartment, and from frame 22 to the instrument panel at frames 27-28. From frame 27 forward, the fabric is installed on the upper sloping car structure so as to enclose the bombardier's compartment. Between frames 21 and 22, the fabric is installed on the upper sloping car structure in a similar fashion, excepting M-1 which had a level ceiling on the port side. Fabric bulkheads are installed above the deck level at frames 11, 14, 21, 22, 24 and 26, and below the deck level at frames 11, 14, 25 and 28. An L-shaped, zippered inspection opening is located in the ceiling on the starboard side between frames 12 and 13, frames 22 and 23, frames 24 and 25, frames 26 and 27, and on the port side between frames 23 and 24 (Dwg. 6092-531 and -540). A fabric floor is installed on the starboard side between frames 11 and 12, and on both sides of the car under the bunks between frames 22 and 24.

L. PILOT'S COMPARTMENT

The pilot's compartment forward of frame 27 extends the full width of the car and accomodates the pilot and co-pilot together with all necessary instruments, controls and accessories for flight operation of the airship.

The pilot and co-pilot sit side by side in chairs located on the port

and starboard sides of the car, respectively, just forward of frame 27 (Dwg. 6090-3). Space is left between the two chairs for an observer. Steel tubular foot rests are provided for the observer (Dwg. 3090-7580) and the pilot (Dwg. 3090-7583). A sliding bulkhead door is installed at frame 26 (Dwg. 6090-1252).

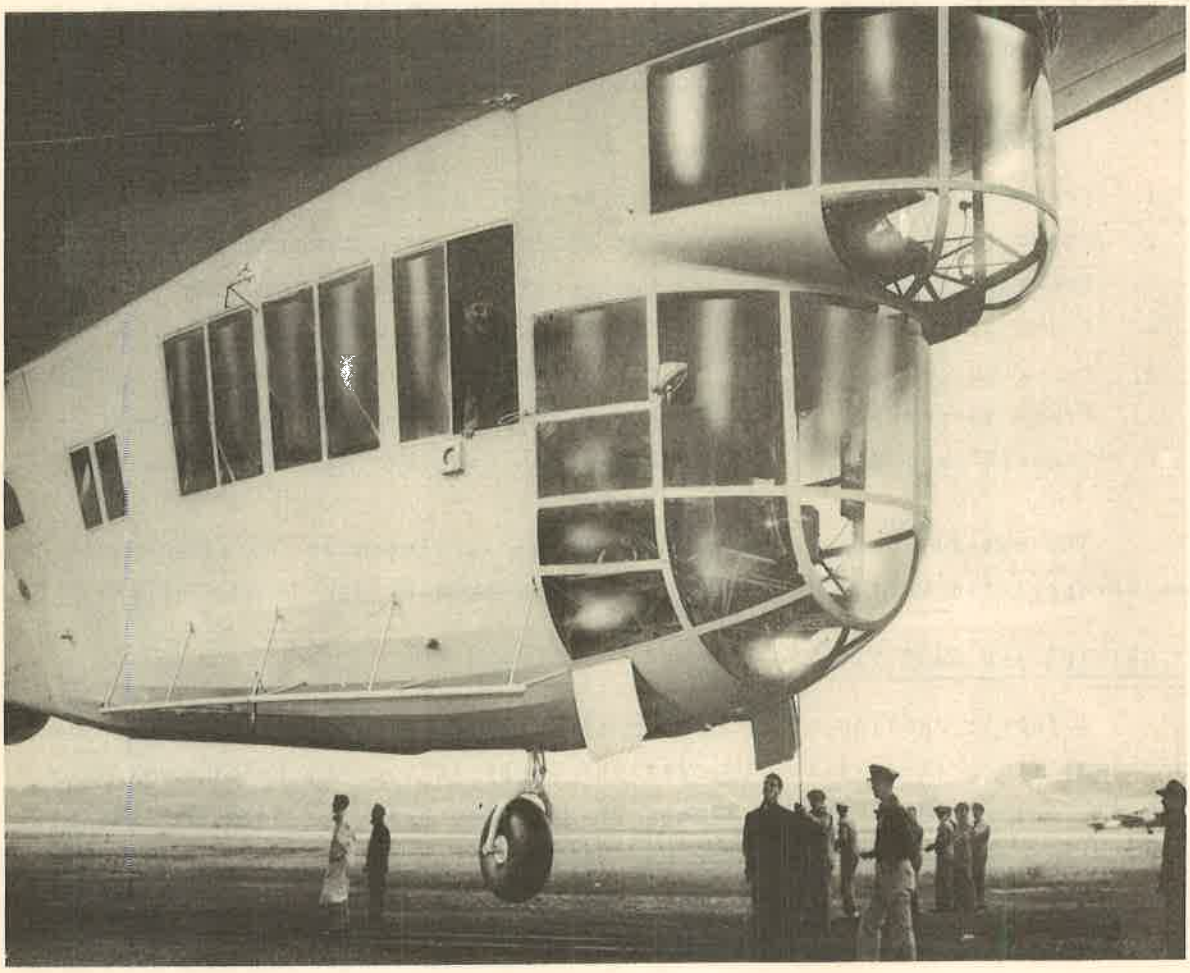


FIG. XXXVI - VIEW OF FORWARD CAR

M. BOMBARDIER'S COMPARTMENT

The bombardier's compartment (Dwg. 6090-1308) is located on the car's centerline at the extreme forward section and above the pilot's bridge. A retractable ladder (Dwg. 4090-5813) at frame 29 on the starboard side of the pilot's compartment provides access to the bombardier's station.

The compartment is constructed of welded steel tubing, framed with aluminum "T" extrusions and covered with transparent plastic which gives the bombardier unrestricted vision ahead, to either side, and below. Bomb bay door and depth charge release controls are located on the starboard side adjacent to his station. A tubular steel footrest is provided as an integral part of the supporting framework (Dwg. 4090-6428 for M-2 and future, 6090-8 for M-1).

A fixed legless plywood chair (Dwg. 4090-1309), equipped with a cushion (Dwg. 3090-1306), is bolted to the car framework.

A platform of 1/2-inch thick plywood and a map box of 1/4-inch thick plywood, the whole forming an assembly approximately 18-inches by 18-inches, is mounted aft of the bombardier's seat (Dwg. 4090-1307).

N. NAVIGATOR'S COMPARTMENT

The navigator's station is directly across the car from the radio compartment. It is on the port side between frames 25 and 26. The navigation equipment consists of a navigator's table, chart rack, light, stool, and all necessary navigating instruments.

A sensitive altimeter (F.S.S.C. 88-A-340) is shock mounted approximately 10-inches above the navigator's table by means of a bracket bolted to the after side of frame 26 (Dwg. 4090-7181).

The navigator's table (Dwg. 4090-1190) is constructed of aluminum alloy with a cover surface, 30-inches x 50-inches of Aeroflor, manufactured by Armstrong Cork Company. The table dimensions, exclusive of the cover, are 27-inches by 46-inches.

Above the navigator's table is a light with an iris diaphragm control, mounted on a universal type arm.

Two drift sight brackets (Dwg. 4090-1207) are mounted on the outer skin of the car at the port and starboard sides between frames 26 and 27.

The navigator's gear rack (Dwg. 4090-6390), consisting of three perforated aluminum chart trays mounted on a plate, is attached to the after side of the sliding door at frame 26.

O. BUNK COMPARTMENT

Four bunks, two to a side, are located one above the other on the port and starboard sides, respectively, of the forward car, between frames 22 and 24 (Dwg. 6090-122).

The upper bunks are hinged along the outboard side and may be swung up against the side of the car when not in use. All four bunks are constructed of aluminum alloy tubing, with heavy

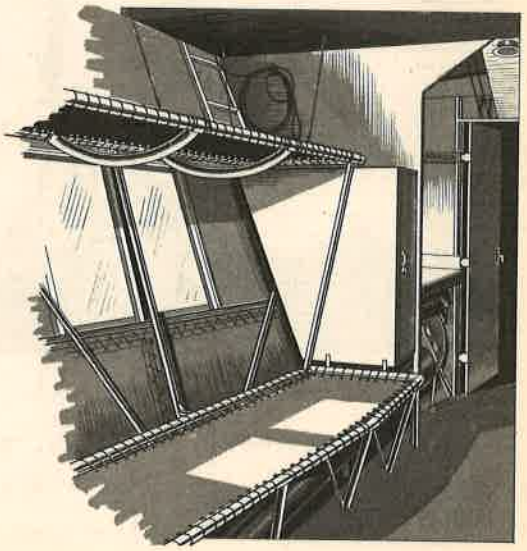


FIG. XXXVII-BUNKS ON STARBOARD SIDE

duck laced to the tubular framework. The two lower bunks may be utilized as seats if desired.

Metal lockers (Dwg. 4090-5916) are installed aft of the bunks and just forward of frame 22 on both the port and starboard sides for storage of personnel gear.

P. GALLEY EQUIPMENT

The galley, located in the forward car on the port and starboard sides between frames 21 and 22, consists of a cabinet electric stove, table surface, and accessory equipment. A door is installed at frame 21 (Dwg. 4090-912).

FIG. XXXVIII - GALLEY STOVE AND SINK

The cabinet stove (Dwg. 6090-151) manufactured by Tappan Stove Company is located on the port side. Within the cabinet of the stove, storage space for cooking utensils is provided, and provisions are made for installation of an oven, should one be desired. The top surface of the cabinet stove is

equipped with two 1000-watt electric coil heating plates, and a wash sink.

A vent door is provided above the stove in the side of the car.

The table surface is located on the starboard side over the car heater unit. The table top, 48-inches by 26-inches is constructed of 3/16-inch 3-ply plywood covered with Armstrong Aeroflor (Dwg. 6090-5998)

A three-section wooden storage shelf (Dwg. 3090-5934) supported by channel members, is mounted in the port and starboard sides approximately 5-feet above the floor level.

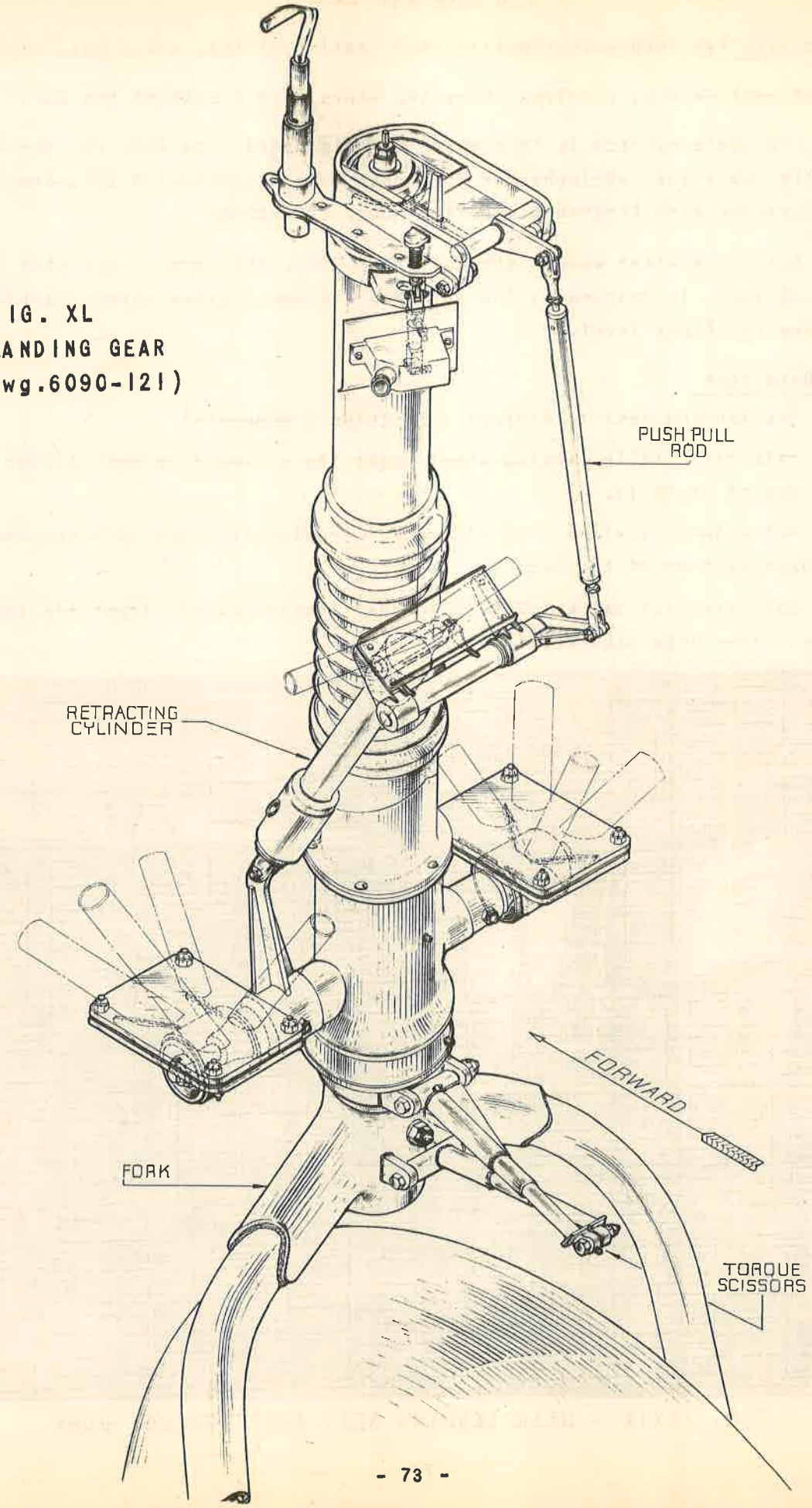
Q. LANDING GEAR

The landing gear is divided into three components:

1. The main retractable landing wheel under the mid-section car blister forward of frame 13.
2. The retractable auxiliary landing wheel located at frame 26 under the forward section of the car.
3. The auxiliary non-retractable tail wheel located on the lower fin structure. (See empennage section).

FIG. XXXIX - MAIN LANDING GEAR AND ENTRANCE DOOR

FIG. XL
MAIN LANDING GEAR
(Ref. Dwg.6090-121)



The main landing wheel assembly (Dwg. 6090-121) consists of a single retractable castering Goodyear Airwheel 40 x 18 x 7, mounted on an Aerol strut located nineteen inches forward of frame 13. The strut and fork of the landing gear are free to swivel through an arc of 360 degrees, and may be locked in the transverse position when the ship is riding out at a mooring mast, Fig. XXXIX and Fig. XL.

The fork and Aerol strut are mounted on an athwartship horizontal trunnion on which the wheel pivots into its retracted or lowered position. Raising or lowering of the wheel is accomplished through the medium of a hydraulic cylinder, which in turn connects to a mechanical linkage at the pivot point.

A telltale indicator light is installed on the mechanic's instrument panel to warn him if the landing wheel fails to return to within 3-1/2-degrees of the fore-and-aft position after taking off, if the wheel fails to lock in position after retraction, or if the wheel fails to lock in position after being lowered. Controls are also located at the mechanic's panel.

Through spring and cam action, the wheel is automatically returned to a fore-and-aft position when the load of the ship is removed from the wheel.

The main landing gear assembly is accessible from within the car, through trap door openings in the floor panels between frames 12-13 and 13-14.

The forward landing wheel assembly (Dwg. 6090-120) consists of a single retractable swiveling Goodyear Airwheel 25 by 11.4, mounted on an Aerol strut located at frame 26. The wheel and fork of the landing gear are free to swivel through an arc of 360-degrees.

The fork and Aerol strut are mounted on a horizontal trunnion on which the wheel pivots into its retracted or lowered position. Raising or lowering of the wheel is accomplished through the medium of a hydraulic cylinder which in turn connects to a mechanical linkage at the pivot point. A telltale indicator light is provided to warn the operator if the wheel fails to return to a fore-and-aft position after takeoff, or if the wheel fails to lock in position after being fully retracted or extended. This light and the controls are located on the starboard side of the airship at frame 26. (See detail A in Fig. LVIII.

Through spring and cam action the wheel is automatically returned to a fore-and-aft position when the load of the ship is removed from the wheel.

R. OUTRIGGERS

The two engine outriggers are constructed of chrome molybdenum steel tubes, Spec. ANWW-T-850 (Dwg. 6090-10) welded into a V shaped framework. The open ends of the V framework are bolted to frames 12 and 13 at the floor and ceiling level on each side of the car.

An engine supporting ring and mount (Dwgs. 6091-291, -292) is bolted solidly to the forward outboard end of each outrigger (Dwg. 6090-86, -5).

A streamlined nacelle cowling constructed mainly of 3S½H alloy sheet, 24SOHT Alclad sheet and 24ST channel stiffeners encloses the accessory side of the engine and provides space for an oil service tank and other necessary equipment (Dwgs. 6090-145, -146). A carburetor air scoop is located at the bottom of each engine nacelle. (Dwg. 6090-890).

The engine is likewise enclosed by a speed ring and three-section removable cowlings (Dwg. 6090-150).

The two outrigger arms are streamlined by a cowling of 24ST Alclad sheet, angle and channel. The lower outrigger arm (Dwg. 6090-59) contains the oil cooler assembly (Dwgs. 4090-699 for M-1; 4090-5728 for M-2 and Future) and the fuel, oil, fire extinguisher, and control lines from the car to the power plant.

The upper outrigger arm (Dwg. 6090-58) incorporates an air scoop for the air system. Folding streamlined metal doors in the leading edge are hydraulically opened or closed from the pilot's panel, or mechanically operated from the mechanic's position in an emergency.

Hinged inspection doors and removable panels are located in the lower outrigger and engine nacelle wherever necessary for inspection and maintenance of the equipment. Clips on the car structure provide for the suspension of a ground work platform.

S. POWER PLANT

1. General Description

Two (2) Pratt & Whitney Wasp engines, type R1340-AN2, Model S3H1G, rated at 550 H.P. each, at 2200 R.P.M., are installed on the engine support rings of the two engine outriggers (Dwg. 6090-86). The engines are mounted in a tractor position and are bolted directly to the engine support rings by nine special bolts (Dwg. 1079-1795) provided with "Lord" rubber insert bushings which act as shock absorbers.

The ratio of engine speed to propeller speed is 3:2. The supercharger impeller is mechanically driven at a ratio of 10:1.

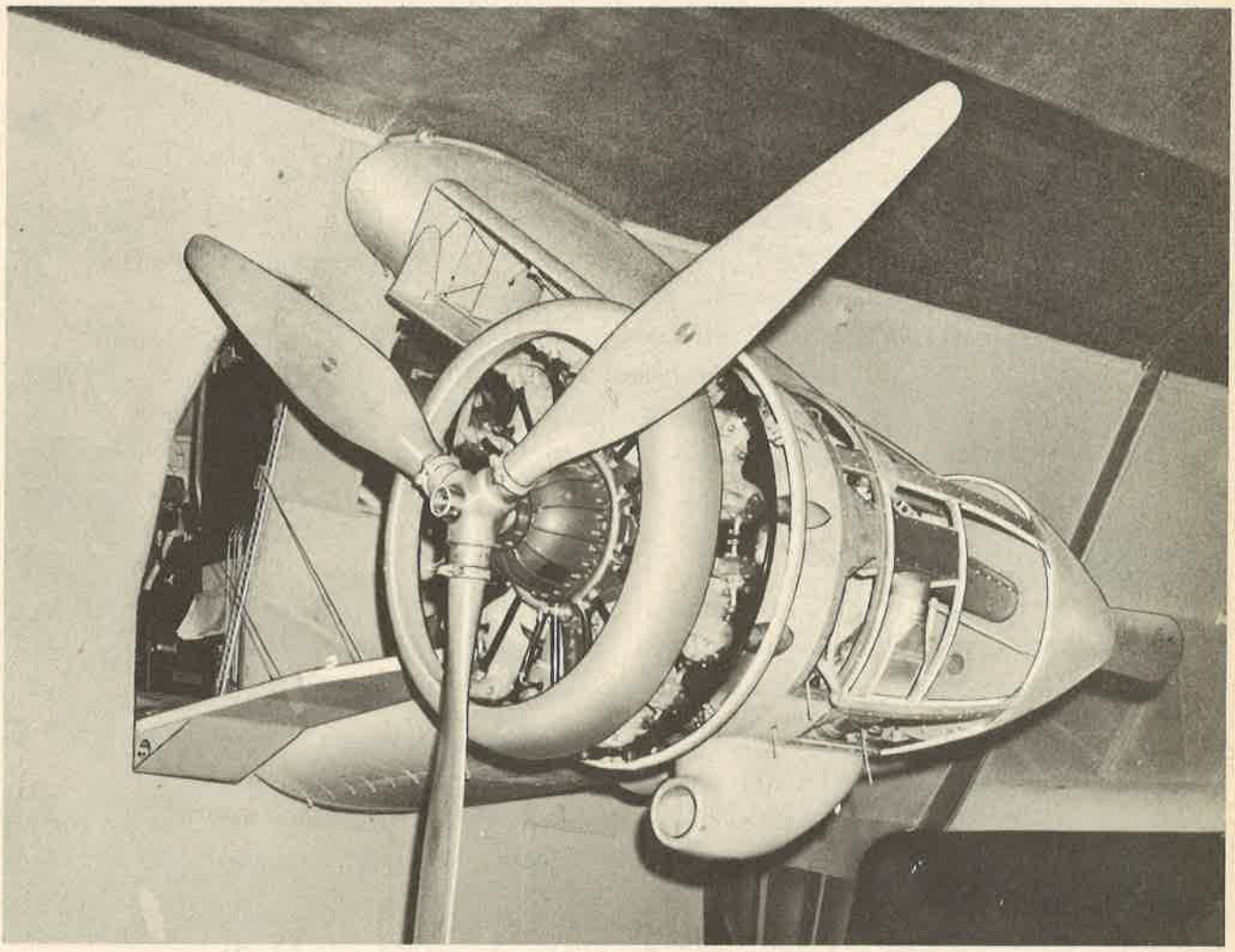


FIG. XLI - POWER PLANT (TEMPORARY PROPELLERS)

2. Propellers

Each engine is equipped with a Curtiss-Wright, electrically controllable, adjustable, reversible and full feathering, 3-bladed, hollow steel propeller with blade shank cuffs.

Other details include:

Model	C532S
(Adapter furnished changes model to C432S)	
Diameter	12'
Blade design	714-1C2-12
Max. Blade Angle at 42" Station	Plus 26°
Min. " " " " "	Plus 16°
Reverse " " " " "	Minus 6°
Feather " " " " "	Plus 89°
Rotation - R.H. (Looking Forward)	

3. Engine Accessories

Each engine is equipped with an Eclipse, Series II, Model 3, Type 429 hand-electric, inertia starter. A hand-crank for cranking the engines is carried in the car on brackets near the mechanic's seat. Adjacent to the crank connection, in the nacelle of each engine, is a control mechanism for engaging the starter. Other equipment installed on the engine includes:

Fuel Pump - Navy type H2E3, Thompson
Carburetor - Navy type NA-Y9E1-510, Stromberg
Magneto - Navy type SB9RN, Bendix (2)
Oil Filter
Oil Heater - Weigand, Type C
Booster Coil - Eclipse, Type T-513
Solenoid mesh - Eclipse #500
Tachometer Generator FSSC-88-G-1375
Vacuum Pump - Pesco (Port Only)
Ignition Shielding

4. Engine Exhaust System

The exhaust from each port is lead through a flexible connection to a collector ring, which in turn connects to an air cooled tail pipe assembly located in the mid section of the engine nacelle (Dwg. 6090-144).

The flexible connection to the engine exhaust ports are of the ball and socket type, and are constructed of stainless steel. The collector ring, also constructed of stainless steel, is located at the forward end of the engine nacelle. Both collector ring and flexible connections are manufactured by the Ryan Aeronautical Company.

The tail pipe assembly, consisting of two pipes cooled by the air passing through a surrounding air shroud or jacket, extends aft from the collector ring through the engine nacelle, and discharges at its after end. The tail pipes, located in the central horizontal plane of the engine nacelle, are on each sice of and symmetrical about the longitudinal centerline of the nacelle (Dwg. 6090-144).

The air shroud, or jacket, surrounding the tail pipes, extends from the forwarc end of the nacelle aft to the last nacelle bulkhead, at which point the hot air discharges through louvers in the after section of the nacelle.

5. Carburetor Induction System

Air is supplied to each engine carburetor by either of two systems:

(a) Cold air by the air scoop located on the bottom of each engine nacelle (Dwg. 6090-890).

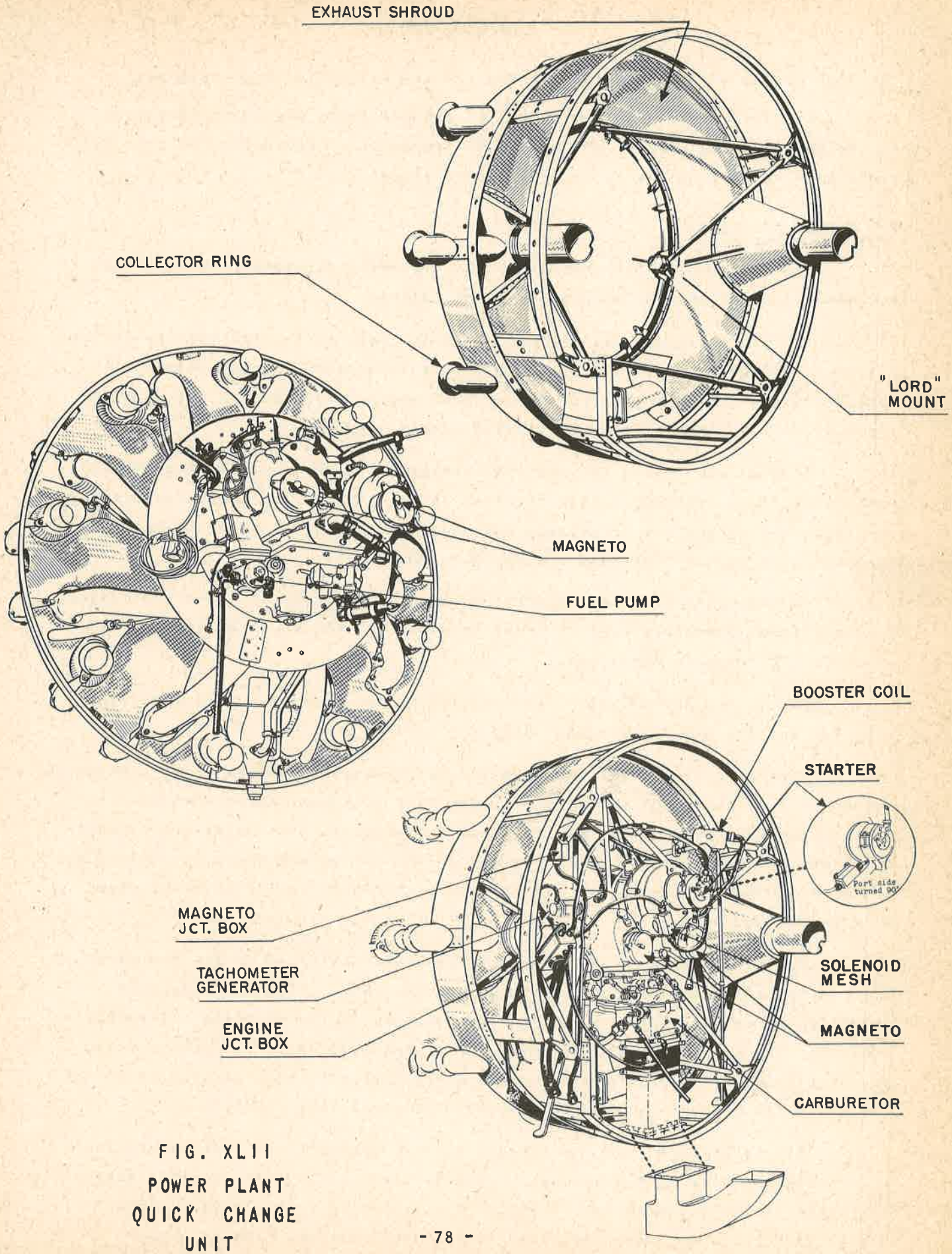


FIG. XLII
POWER PLANT
QUICK CHANGE
UNIT

(b) Hot air by a takeoff line from the air shroud system (Dwg. 6090-144).

A valve, located in the throat of the air scoop and controlled from the mechanic's compartment, allows either system or a combination of both (a mixture of hot and cold air) to be selected at will.

T. ENGINE CONTROLS

The engine controls consist of the hydraulic throttle controls, and the mechanical carburetor heat and mixture controls.

The hydraulic engine throttle controls consist of a transmitter at the pilot's location (Type EICI-A Spec. S513C), a transmitter at the mechanic's location (Type JOC-I) and a receiver at each engine (Type EICI-A Spec. S514D). These units are manufactured by Sperry Products Inc.

Through cam action the receiver operates the lever arm linkage on the carburetor (Dwg. 6090-90). This receiver is actuated by the hydraulic pressure of either the mechanic's or pilot's transmitter to which it is connected by a single length of 1/4-inch 52S0 tubing (Dwg. 4090-882).

Two manually operated bleeder valves are installed at the highest part of the system (starboard side of frame 28 above car ceiling) for elimination of any air trapped in the lines.

For tubing installation refer to hydraulic system drawings 6090-139, -140 for M-1 and M-2; 6090-7393, -7392 for M-3 and M-4.

A throttle interlock (Dwg. 6090-7140) is mounted on the pilot's throttle control. By a system of two solenoids and four switches interconnected with the reverse and the reverse return propeller switches, this interlock electrically and mechanically prevents reversal of the propellers while the throttles are in an advanced position. The wiring diagram for this installation is given on drawing 6090-5639.

A modified type of throttle interlock was installed on the M-4 airship. This installation utilized an electric magnetic valve connected into each throttle hydraulic line and energized by switches on the mechanic's throttle control. The wiring diagram is given on drawing 6090-7915. A Curtiss relay No. 102017-20 was incorporated into the circuit permitting a simplification of the propeller control switches on the pilot's panel (Dwg. 4090-7913).

The carburetor heat and air-gas mixture controls are attached to the lower outboard side of the mechanic's panel, Fig. XLVII. The control quadrants are of the standard type in which the rich mixture and cold air are in the forward position (Dwg. 3079-5040) Aero Supply #24387. These quadrant

levers are connected to the carburetor and air induction systems by means of Simmonds Corsey control lines. These lines consist of rigid and flexible tubing enclosing a series of olive shaped and tubular shaped beads strung on aircraft cable (Dwgs. 6090-90, -1209).

An emergency manual throttle control is located on the inboard side of each engine nacelle, and is accessible from the outrigger access doors. At the time of this writing, it is proposed to extend this control to the mechanic's station.

U. INSTRUMENT PANELS

1. Pilot's Panel and Controls

The pilot's instrument panel (Dwg. 6090-123), which extends the full width of the car, is located at frame 28 and slopes upward and aft toward frame 27 at an angle of about 35-degrees from the vertical. This main panel of black lacquered aluminum alloy construction contains the following instruments:

1 - Air Speed Indicator - Dwg. 4090-1078-4
2 - Tachometer Indicators - FSSC-88-1-2500
1 - Mechanical Manometer - 1406-40A-A1 Type 526C
1 - Air temperature Indicator - FSSC-88-1-2865
1 - MAD Remote Millimeter - MOD-321; 500-0-500
1 - Superheat Thermometer Indicator - NBS-45-42
1 - Pitch Indicator - Rieker #1018
1 - Clock - FSSC-88-C-570
1 - Fullness Indicator - 3090-5644
1 - Air Scoop Indicator - Selsyn D-J-12
4 - Ballast Tank Gauges
1 - Checkoff and Landing List
1 - Chart - Prop Pitch Operation - 2090-7199
1 - Fuel Tank Location Chart - 3090-7293
1 - Superheat Chart
1 - Fuel Diagram Chart
1 - Helium Purity Meter Outlet - Dwg. 1090-4468
2 - Tel-Light Assem. - #110992
1 - MAD Remote Meter Light
4 - Fuel Dump Control Knobs
4 - Ballast Dump Knobs
1 - Safety Switch Control Knob
6 - Damper Valve Controls (Forward, Middle, After Ballonets, Port and Starboard)
6 - Air Valve Controls (Forward, Middle, After Ballonets, Open and Close)
1 - Helium Maneuvering Valve Controls (Open Only)
4 - Helium Valve Controls (Open and Close)

2 - Handling Line Release Controls
1 - IFF Control Unit (Detonator, Emergency, On & Off Switches)
3 - Ultra Violet Instrument Light Switches - NAF 1192-1
2 - Propeller Circuit Breakers - Curtiss Wright #109050
*2 - Propeller Feather Switches - Curtiss Wright #104029 (M-1 thru M-3 only)
*2 - Propeller Reverse - Normal Switches (M-1 thru M-3 only)
*2 - Propeller Normal - Reverse Switches (Changed to double pole type for M-4)
10 - Klixon Breakers
2 - Magneto Switches for Main Engines - AN3027-2B
**2 - Magneto Switches for Generators - AN3027-2B
1 - Circuit Breaker and Toggle Switch (Landing Light) - 15A-1
1 - Toggle Switch and Light - AN-301-A
6 - Toggle Switches (Instruments, dome light, pitch indicator and misc.)
2 - Air Scoop Control Switches
2 - Electric Blower Switches
4 - Slip Tank Release Switches - AN-3016

* On the M-4 panel, the two propeller feathering switches and two circuit breakers were moved to the mechanic's location, and the two normal-to-reverse and reverse-to-normal switches were replaced by two double-pole type switches.

** Disconnected on M-3 and M-4.

Directly in front of and above the pilot, on a rubber shock-mounted sub-panel in the main panel assembly, are located the two electric engine tachometers, the mechanical manometer, the air temperature indicator, the Bureau of Standards Superheat thermometer, MAD remote control, the air speed indicator, and the clock. Below the sub-panel are located the controls for the propellers, scoops, damper valves, air valves, and helium valves and a shock mounted scoop indicator gauge. The helium valve controls are protected by a hinged metal cover to prevent accidental opening.

On the left of the sub-panel are located the safety switch, the ultra-violet light rheostat for the pilot's instrument panel, the helium purity indicator, the propeller control, and blower magneto grounding switches. To the right of the sub-panel is the superheat chart and pitch indicator.

In the center of the main instrument panel is a schematic drawing of the car plan showing the relative location of all fuel tanks with respect to the car frames. On either side of this schematic layout are the release controls for the slip tanks, and the fuel and ballast dump tanks. The four slip tank release levers are shielded by a hinged cover to avoid accidental or unintentional release. To the right of the schematic fuel tank location are

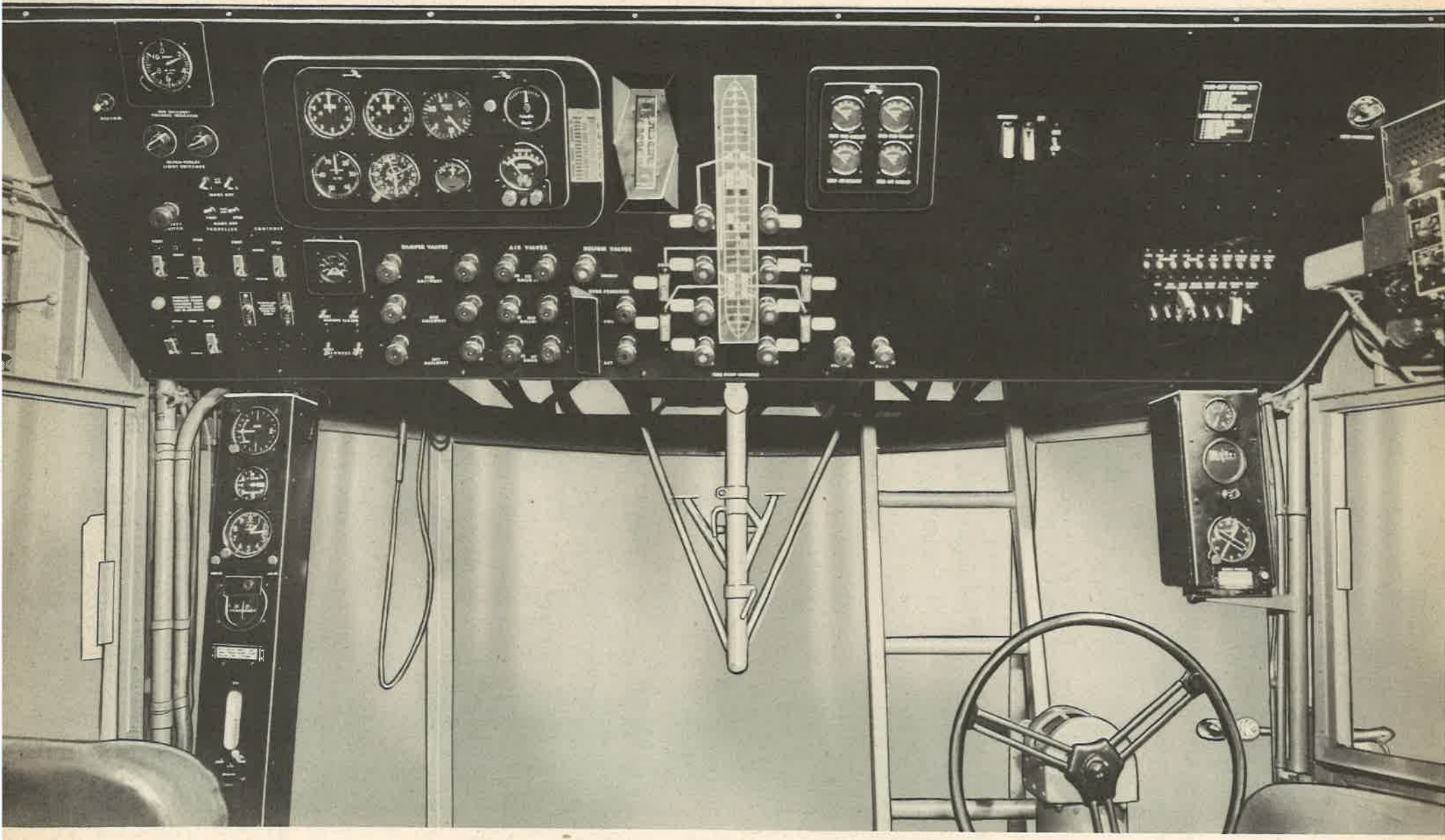


FIG. XLIII - VIEW OF INSTRUMENT AND FLIGHT PANELS

located the four ballast gauges on a rubber shock-mounted sub-panel. Directly below the ballast gauge sub-panel are the handling line release toggles. To the right of the ballast gauge panel is an emergency switch for the IFF unit. On the extreme starboard side of the panel are the take-off and landing list check chart, the co-pilot's ultra-violet light rheostat, and the switch and breaker box panel assembly.

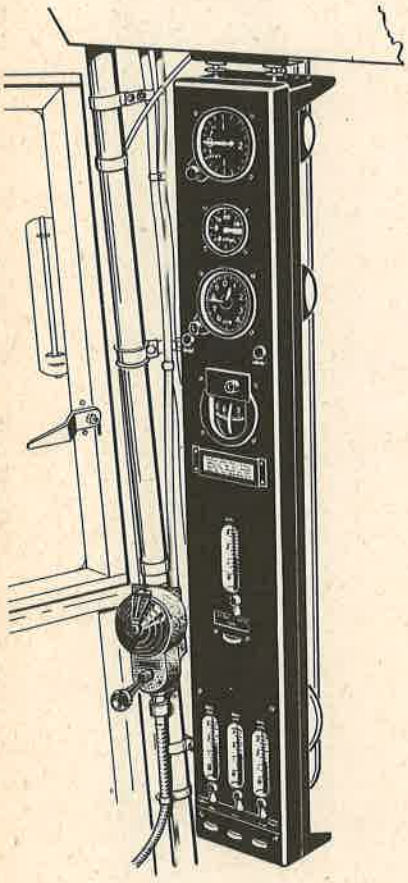


FIG. XLIV
FLIGHT PANEL
ELEVATOR PILOT

2. Flight Panel - Elevator Pilot

The flight instrument panel is rubber shock-mounted at the vertical window panel at frame 28 on the port side of the pilot's compartment, Fig. XLIII and Fig. XLIV (Dwg. 6090-125, -1110). In the flight instrument panel reading from top to bottom are the following instruments:

Vertical Speed Indicator - Kollsman, FSSC-88-I-725 (Navy type)

Elevator Position Indicator - Selsyn 8DJII-PAH

Sensitive Altimeter - Navy Model FSSC-88-275 (with fitting AN-816-4D)

Helium Valves Warning Lights - Grimes Mfg. Co. A-2328

Compass - Navy Model, Mark VIII

Gas Manometer Assembly (Dwg. 4090-1086)

Air Manometer Assembly (3) (Dwg. 4090-1088)

3. Flight Panel - Rudder Pilot

The Rudder Pilot's panel (Dwg. 6090-7930) is attached by brackets and rubber shock-mounts to frame 28 immediately below the starboard side of the main instrument panel, Fig. XLIII and Fig. XLV. On it are mounted the following instruments:

Suction Gauge - FSSC-88-G-925

Directional Gyro - AN-5735-1

Remote Compass Indicator - AN-5730-2A

Compass Correction Card and Holder

Indicator Light - NAF-1056-16

The remote reading compass on the rudder pilot's flight panel is connected to an AN5730-3 transmitter located in a housing mounted on the envelope forward and to the starboard of the car. The inverter is bolted to the car structure at ceiling level between frames 27 and 28, and the on-off switch is mounted on the main instrument panel. (Dwg. 6090-97).

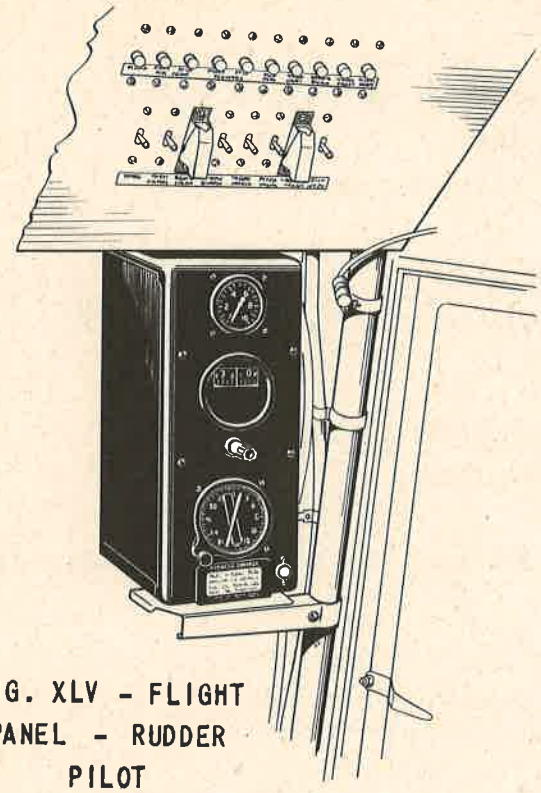


FIG. XLV - FLIGHT PANEL - RUDDER PILOT

panel cover. Actual release of the bombs is controlled by a pistol type trigger switch (NAF-1174-1) connected to the panel by flexible electric cord.

5. Mechanic's Panel and Controls

Located between frames 12 and 13, on the port side of the car, is the mechanic's station, which includes all engine controls and instruments necessary for the operation of the engines. (Dwg. 6090-124).

The engine and propeller controls terminating at the mechanic's station include:

Main Throttle Controls (2)
Emergency Throttle Controls (2)-(pending)
Mixture Controls (2)
Air Intake Controls (2)
Engine Primer (1)
Propeller Increase-Decrease RPM Switches (2)
Propeller Feathering Switches (2) M-4 only

4. Bombardier's Panel

The Bombardier's panel (Dwg. 6090-7296) is solidly mounted on brackets at the upper starboard side of frame 29, adjacent to the bombardier's chair.

The panel is a 24ST aluminum alloy base with a hinged cover, approximately 3 x 9 x 17-inches. On the hinged cover are mounted the twelve toggle switches (AN-3051) and twelve indicating lights (Grimes A-2328) for operation of the bomb bay doors, the bomb arming devices, and the bomb release shackles. A toggle breaker type switch (Square D - Type A-1), an ultra-violet light switch, and an instruction plate are also mounted on the

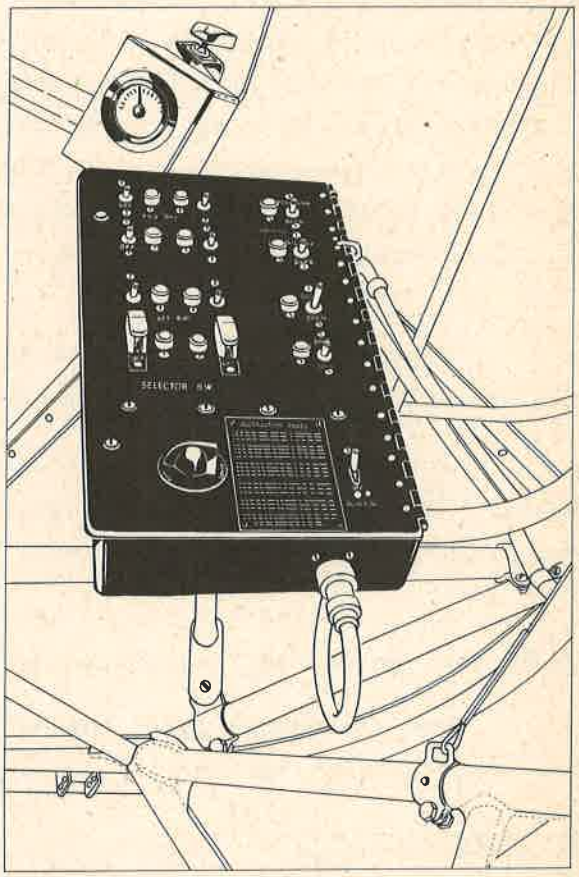


FIG. XLVI - BOMBARDIER'S PANEL

Mounted on the mechanic's instrument panel, in addition to the above, are the following instruments and controls:

1 - Line Diagram Hydraulic System on back of panel (M-1 and M-2 only)
2 - Curtiss Wright #110992 Propeller Tel Lights
2 - Electric Engine Tachometer Indicators, FSSC-88-1-2500
1 - Synchroscope, FSCC-88-1-2200
2 - Manifold Pressure Gauges, FSCC-88-G-700
2 - Engine Gage Units (Oil Pressure, Oil Temperature, and Fuel Pressure), FSSC-88-U-310.
2 - Oil Level Indicators, GAC-3079-201
2 - Carburetor Air Intake Temperature Gauges, FSSC-88-1-2815
1 - Cylinder Temperature Indicator, FSSC-88-1-2655
1 - Clock, FSSC-88-C-570
2 - Ammeters for 2 Lawrence Generators, 1091C-480, and Battery, NAF-1091D-120
1 - Voltmeter, Weston Model 606 1091E-30
1 - Voltmeter Selector Switch, Yaxley #1316L
1 - Rheostat, Grimes A2334A (Ultra-violet Light)
2 - Ignition Switches, NAF-1125-11
2 - Generator Switches, AN3023-2B
2 - Starter Mech. Switches, AN3019, and 1 Starter Switch, AN3018
1 - Control for Lux Fire Extinguisher System in Engine Nacelles
2 - Oil Pressure Warning Lights, Grimes A2328
1 - Flasher Light for Navigating Lights, Grimes A2328
5 - Light Switches, Square D Class 9300 Type 15A1
1 - Reco Flasher Unit, #3090-4554

The main junction box for the electrical system is mounted in front of the mechanic's chair, directly under the instrument panel.

A hinged shelf is installed at the lower port side of the control board. The top of this shelf contains a schematic layout of the fuel system for ready reference and also serves as a writing surface.

The lighting and electrical connections for the instruments are shown under the section on "Electrical System".

The instrument panel cabinet is constructed of aluminum alloy and finished in black lacquer.

6. Breaker Panel

The main fuse box (Dwg. 4090-1087 for M-1, M-2 and M-3) is mounted on the upper outboard side of the mechanic's panel and contains Spencer Klixon

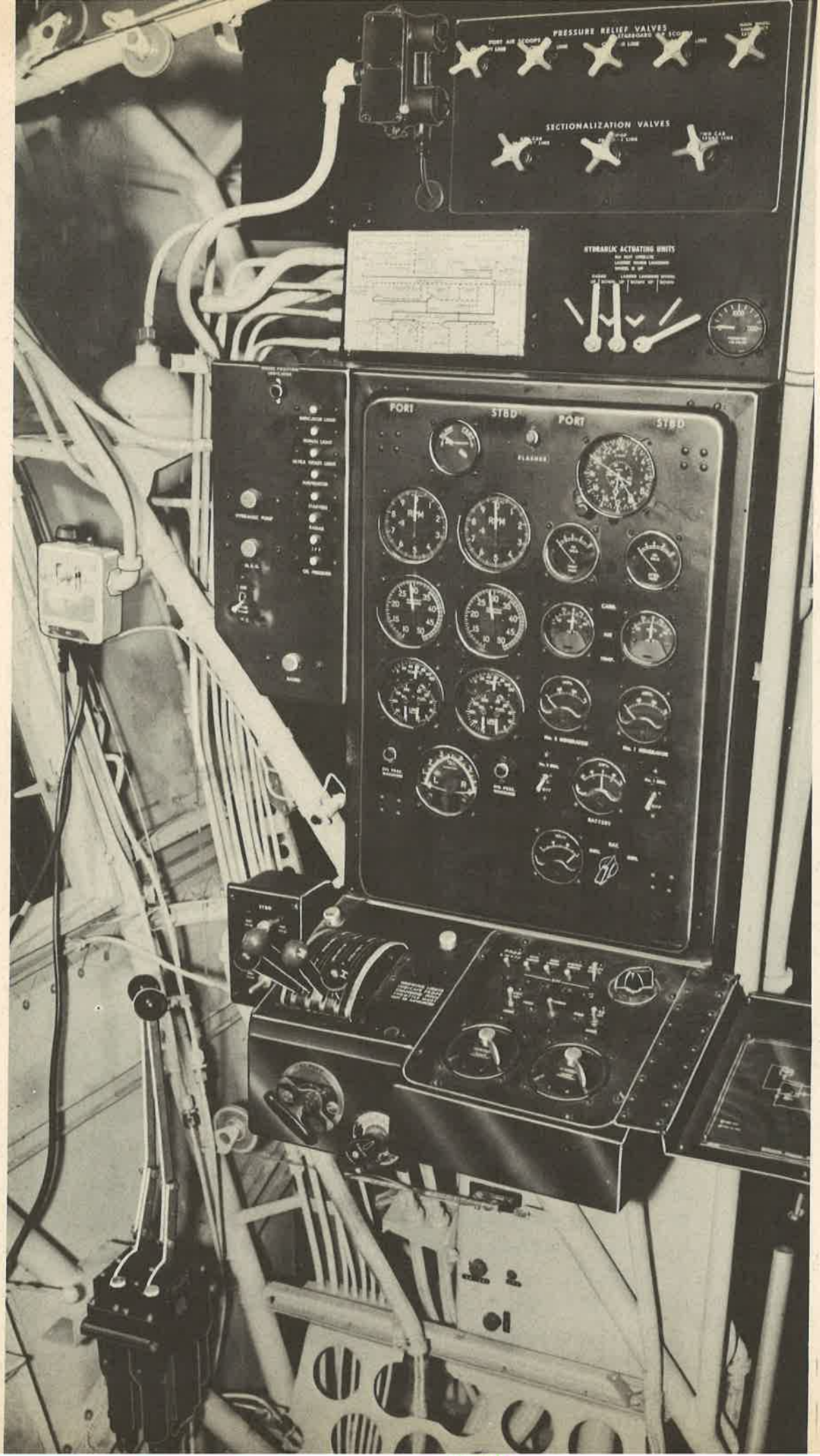


FIG. XLVII

MECHANIC'S PANEL AND CONTROLS

circuit breakers for the following:

Indicator Light
Signal Light
Ultra-violet Light
Navigator's Light
Radar
IFF
Oil Pressure Lights
Hydraulic Pump
M.A.D.
Radio

The panel also contains a hydraulic pump switch, a starting contactor for the pump motor, and an indicating light for the main landing wheel, Fig. XLVII.

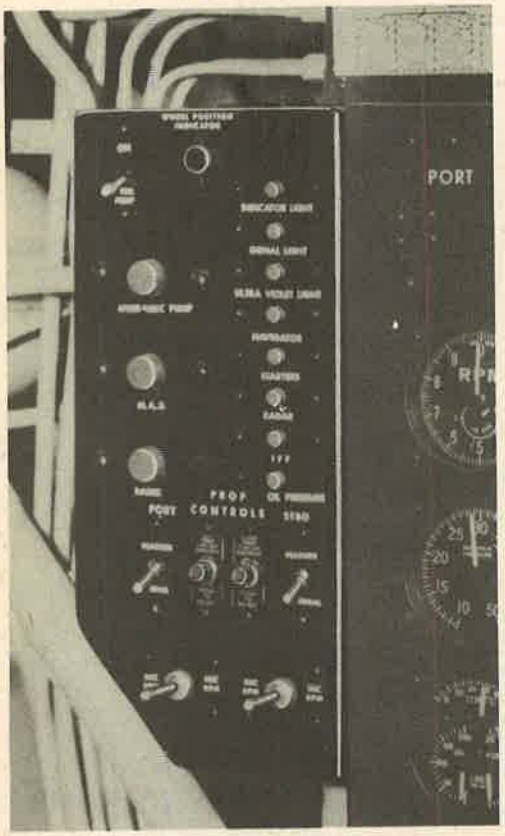


FIG. XLVIII-BREAKER PANEL

On the M-4 airship the arrangement of the units on the panel was changed slightly (Dwg. 4090-7892) Fig. XLVIII, and the following items were added:

1. Propeller increase-decrease RPM switches (2) (Moved from junction box at lower outboard side of mechanic's panel).
2. Propeller feathering switches (2) (Moved from pilot's panel).
3. Propeller circuit breakers (2) (Moved from pilot's panel).

7. Hydraulic Panel

The hydraulic panel is mounted directly over the mechanic's panel and contains the major part of all controls necessary for the operation of the hydraulic system as follows:

(a) 1 Pressure Gauge, AW-1-7/8-17-C U.S. Gauge Co.

(b) 1 4-bank 4-way Valve, Adel Prod. D9841 for:

Radar	Extend	Retract	Neutral
Ladder	"	"	"
Main Wheel	"	"	"

Accumulator - Pressure - Reservoir - Neutral
(Accessible from rear of panel)

(c) 5 Pressure Relief Valves for air scoops and main landing wheel.

(d) 3 Sectionalization Valves for, forward car section, aft car section and scoop pressure line.

Other major items located on the panel are:

(a) 1 Reservoir (back of panel)

(b) 2 4-way Solenoid Valves (remote control of air scoops)

(c) 1 Filter

(d) 1 Pressure Switch

(e) 4 Check Valves, 8 Thermal Relief Valves, 1 Main Relief Valve (Only 5 thermal relief valves on M-1 and M-2).

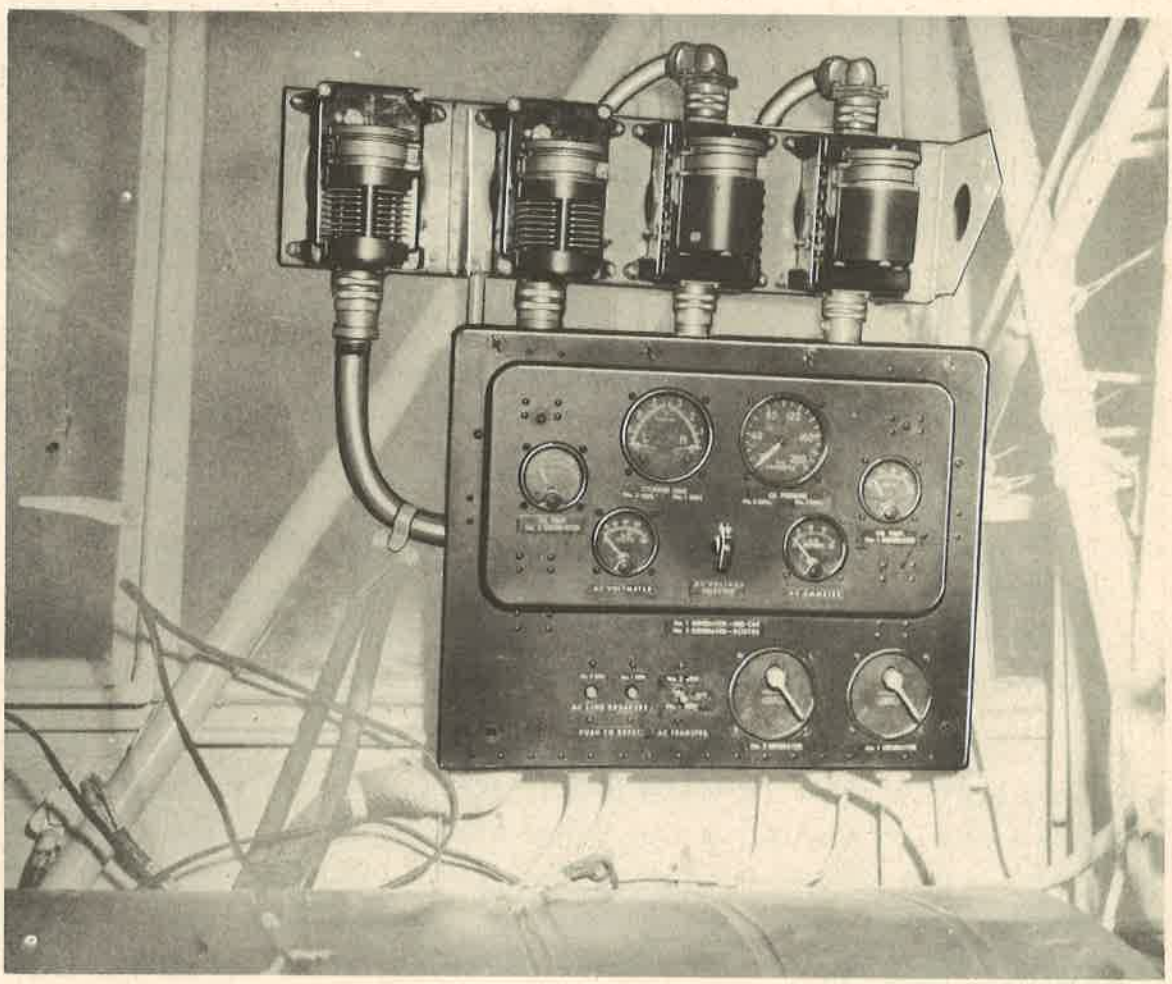


FIG. XLIX - GENERATOR PANEL AND REGULATORS

The panel for M-1 and M-2 airships was constructed as an integral part of the airship (Dwg. 6090-1211). The panel assembly for M-3 and M-4 airships is provided with bulkhead fittings so that the entire panel assembly may be quickly removed for testing or repair purposes, Detail A, Fig. LIX (Dwg. 6090-7390).

A line diagram of the hydraulic system is mounted on the front of the panel for M-3 and M-4 airships (Dwg. 4090-7690), and on the rear of the mechanic's panel for M-1 (Dwg. 3090-6069) and M-2 (Dwg. 6090-7700).

8. Generator Panel

An instrument panel for the generator system is mounted above the Lawrence generator unit at frame 13 on the starboard side of the mechanic's compartment. The instrument panel (Dwg. 6090-5580) contains the following instruments on a rubber shock-mounted sub-panel:

(a) Cylinder Temperature Gauge - Dual (1) 0°-600° F. FSSC-88-1-2655
(b) Oil Pressure Gauge - Dual (1) 0-200 p.s.i. AN5772-2
(c) Oil Temperature Gauge (2) Minus 10°-120° C. FSSC-88-1-2815
(d) A.C. Voltmeter (1) 0-150 V. Weston 833
(e) A.C. Ammeter (1) 0-20 A. Weston 833
(f) Voltmeter Selector Switch (1) AN 1038

Immediately below the above instruments are mounted two magneto switches NAF-1125-11, two circuit breakers PSM-20, and a D.P. transfer switch AN3023-1B.

V. MAJOR CONTROLS

The major control system consists of the wheels, shafting, gears, cables, and fixtures necessary to operate the four movable control surfaces in the empennage. The rudders are operated by a rudder wheel mounted on a capstan directly in front of the co-pilot's chair, with its shaft parallel to the airship's longitudinal axis. The elevators are operated by a wheel mounted on the inboard side of the pilot's chair with its shaft transverse to the airship's longitudinal axis. Both the rudder and elevator mechanisms are equipped with a foot brake for locking the respective controls in the position desired.

The rudder wheel is 18-inches in diameter and is mounted on a sliding fore-and-aft shaft so that it may be adjusted to suit the pilot (Dwg. 6090-103). A Plexiglas window is mounted in the top of the capstan for visual observance of the rudder chain. The wheel shaft is connected to a fore-and-aft shaft, below the floor level, by a chain and sprocket drive at frame 28. The aft end of this shaft transmits the motion to a vertical pulley and cable system at frame 26. From the ceiling line of the car structure at frame 26, the 7/32-inch diameter rudder cables run to the extreme aft end of the car over a pulley and fairlead system. At the aft end of the car, the cables leave the car and travel along the under side of the envelope to the empennage surfaces.

The elevator wheel is 22-inches in diameter and is mounted on the inboard side of the pilot's chair. The wheel is connected by a chain and

sprocket drive to a similar drive below the floor level at frame 27, which in turn transmits the motion to a vertical pulley and cable system at frame 26 similar to that for the rudder.

An adjustable spring and pulley cable tensioning device is provided between frames 10 and 11 to insure adequate control of all cable tensions. (Dwg. 6090-790).

Shunt cables are installed for both the rudder and elevator chains to prevent the chains from coming off the sprockets. Lugs are attached at the junction points of the chains and cables. These lugs contact stop bolts through the chain guards, thus preventing excessive movement of the control surfaces. In addition to these stops in the cable lines, positive stops are located on each fin so that the movable surfaces come in contact with and are stopped by brackets mounted on the fins.

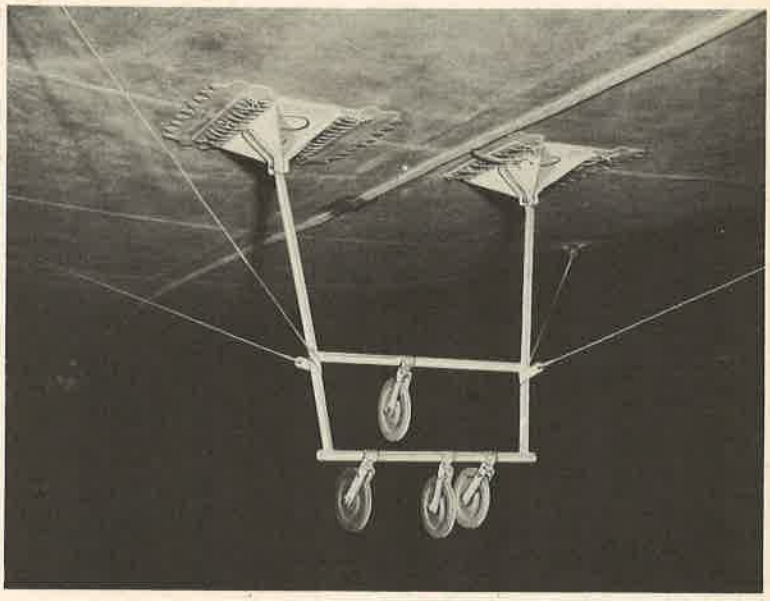


FIG. L
MAJOR CONTROL
CABLE GUIDE

After leaving the aft end of the car, the control lines pass over a control line guide (Fig. L) (Dwg. 4093-121), constructed of tubing and secured to the envelope by brace cables and patches. Aft of this guide the cables are bifurcated and pass to each side of the lower vertical fin.

Pulley brackets, installed on the fin surfaces, direct the cable lines to their proper surfaces (Dwg. 4092-21). The cable lines for the upper three surfaces all pass through a common three-pulley bracket on each side of the lower fin, from which point they are directed to the upper rudder and elevators. The top rudder line and the elevator lines on each side of the ship pass through tunnels in the horizontal fins. Brackets with fairleads are provided on the lower fin surface and envelope to prevent the cable control lines from chafing the fin fabric. Brackets with pulleys are provided between the horizontal

and lower vertical fins, and fairlead brackets are provided between the horizontal and upper vertical fin to prevent chafing of the envelope fabric.

The control lines, from the wheel chains to the point forward of the fins where they divide to go to each side of the empennage, are 7/32-inch diameter cables. From these dividing points to the rudder and elevator posts, the lines are 5/32-inch diameter cables. Micarta pulleys are used through the system with the exception of the car pulleys forward of frame 26, at frame 13, and aft of frame 1, and pulleys on the envelope and aft fin surfaces. These latter pulleys are made of aluminum alloy, thus providing an electrical bond of the cable system to the car structure.

The assembly of the major control system in the car is shown on drawings 6090-1, -2, -3, -101, -102, -103 and that part of the system on the envelope and control surfaces is shown on drawing 4092-21.

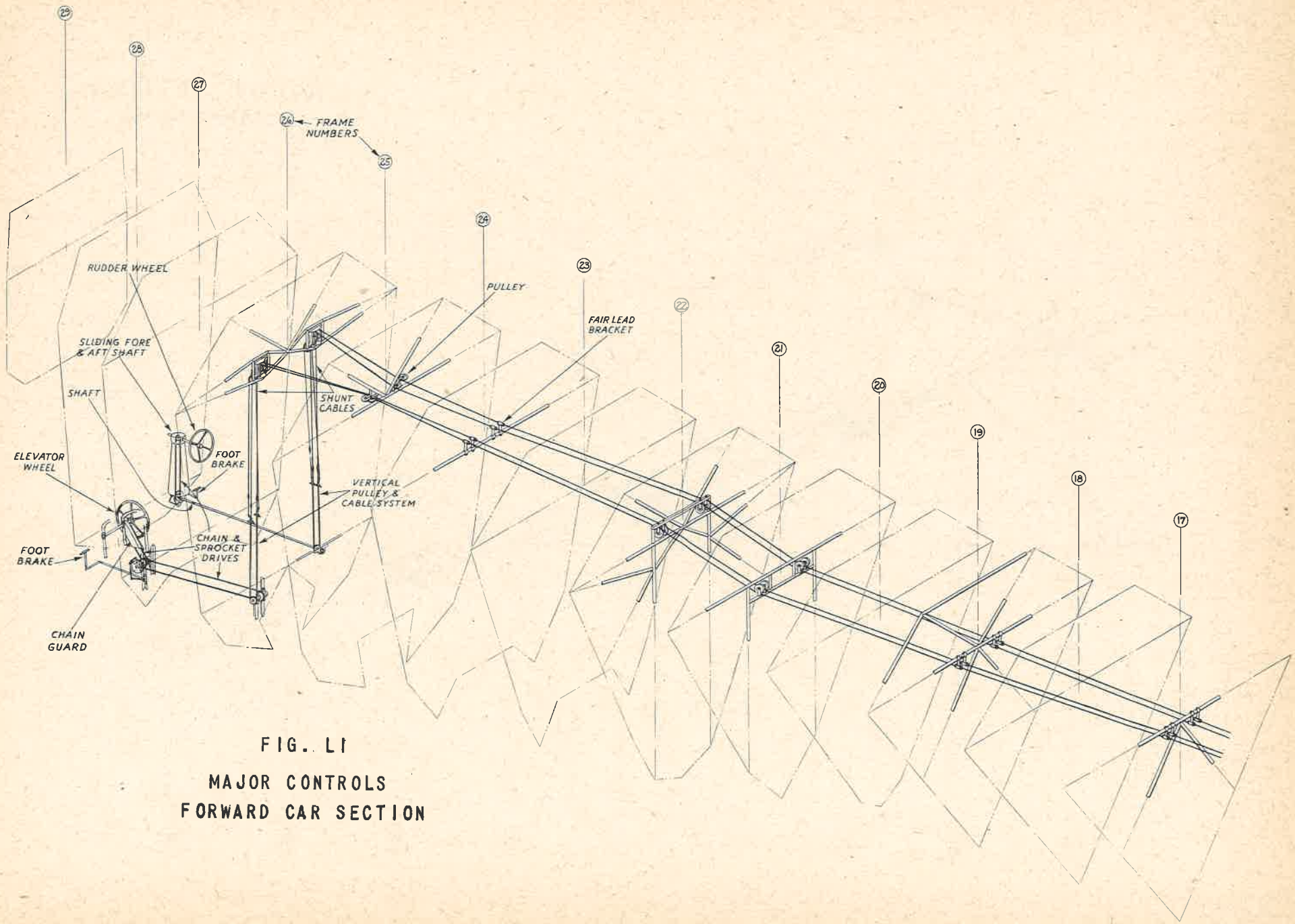


FIG. LI

MAJOR CONTROLS

FORWARD CAR SECTION

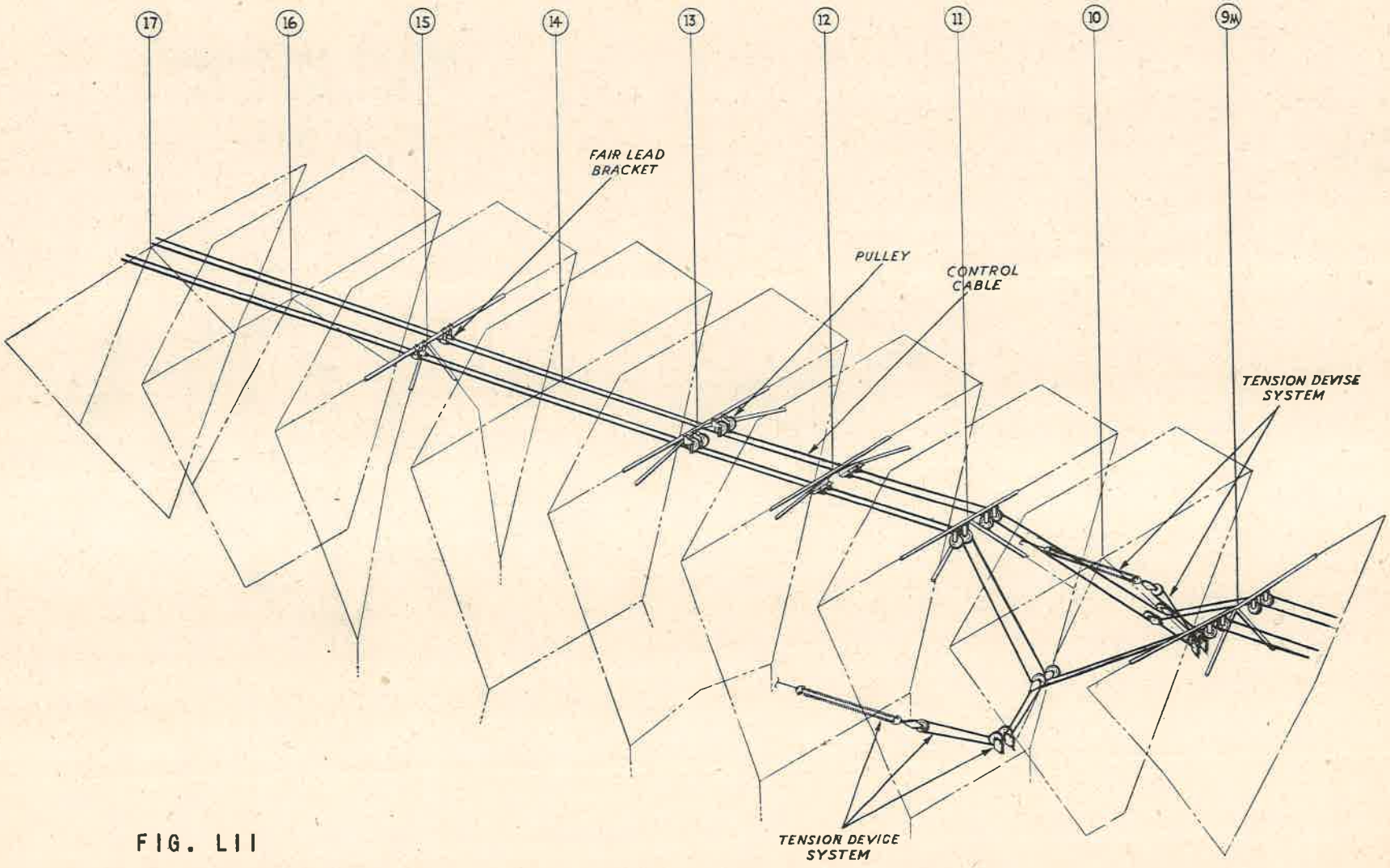


FIG. LII

MAJOR CONTROLS

MIDDLE CAR SECTION

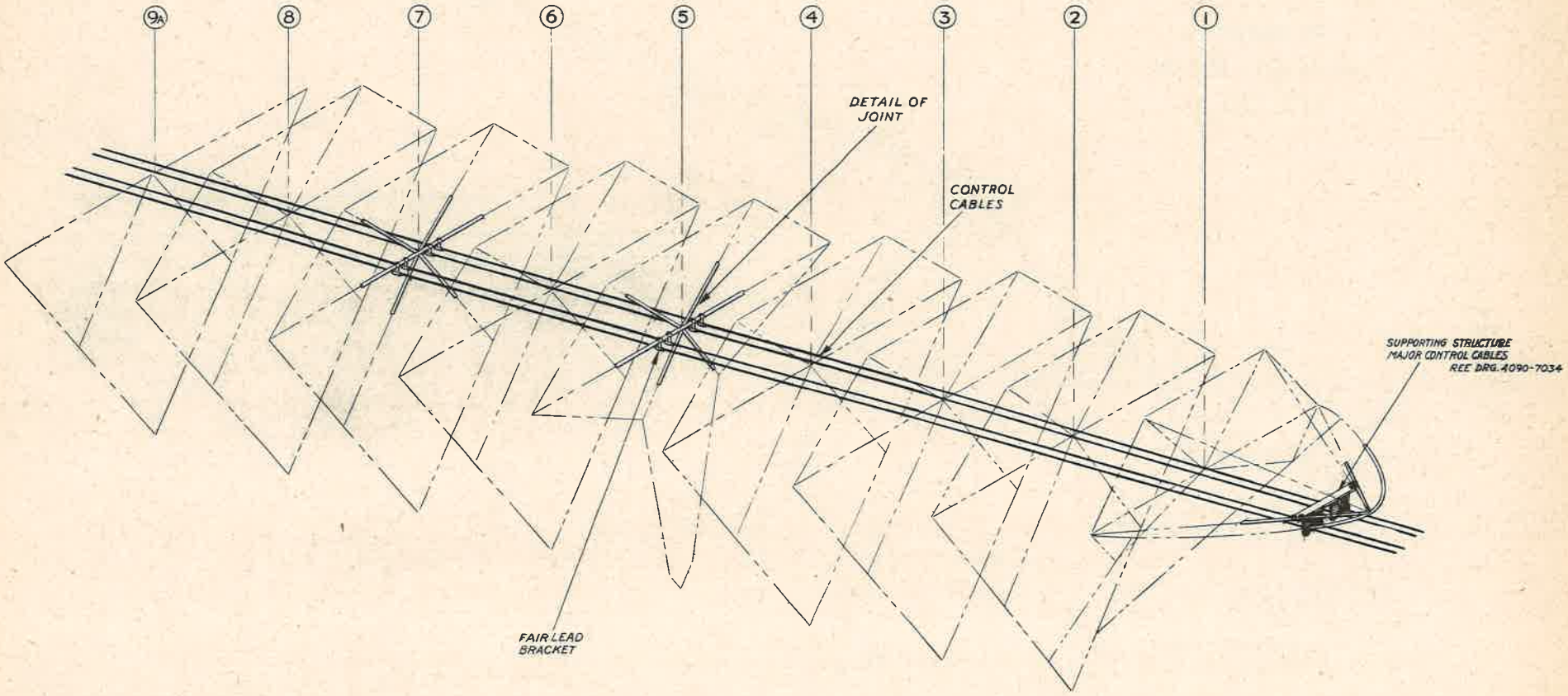


FIG. LIII

MAJOR CONTROLS

AFTER CAR SECTION

ITEM	DESCRIPTION
1.	Control Cable - Elevator - Bottom
2.	Control Cable - Elevator - Top
3.	Control cable - Rudder
4.	Major Control Cable Guide
5.	Fairlead Bracket
6.	Pulley Bracket
7.	Control Cable - Rudder
8.	Pulley Bracket

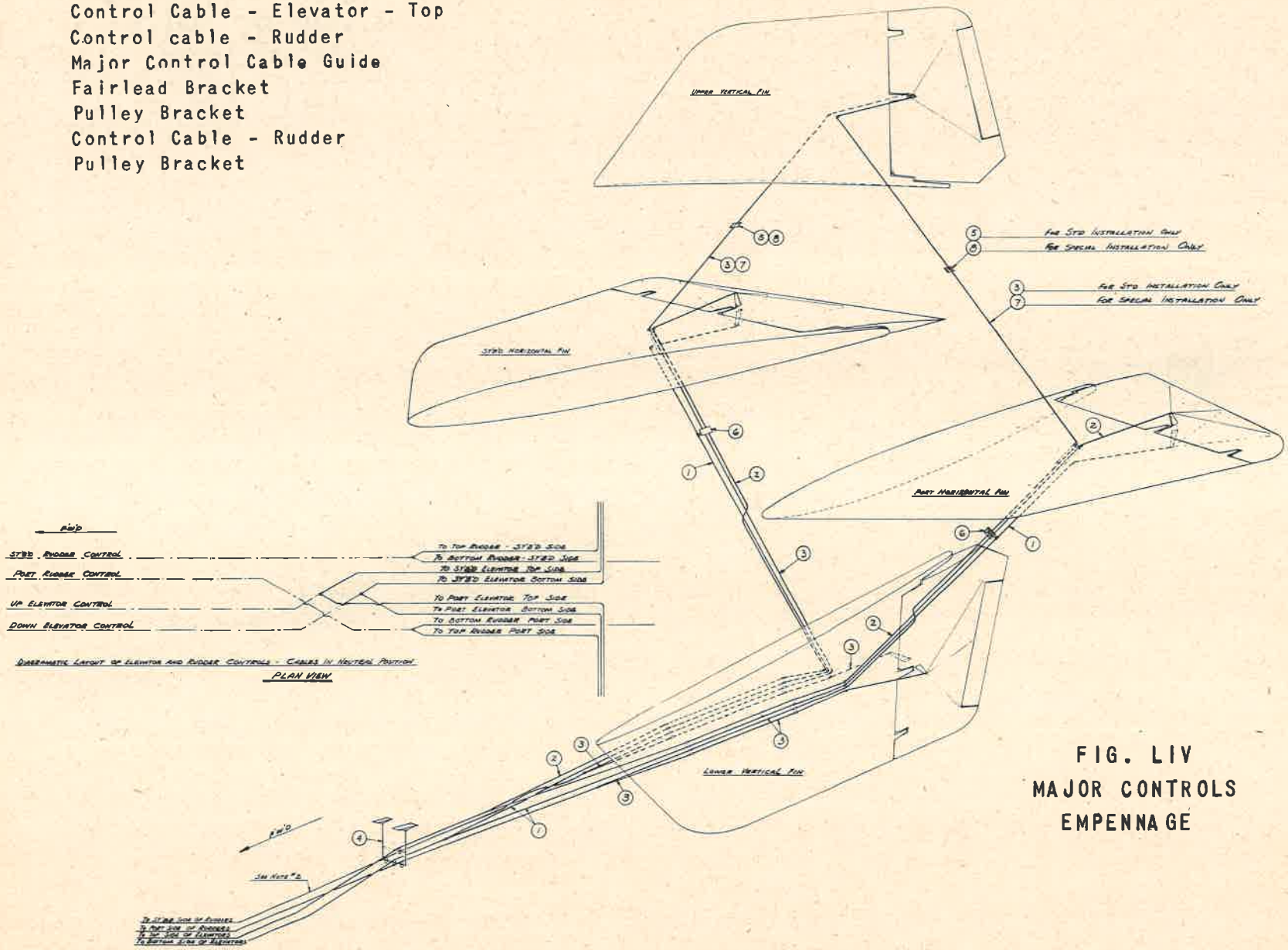

UPPER VERTICAL FIN
STBD HORIZONTAL FIN
PORT HORIZONTAL FIN
LOWER VERTICAL FIN
FOR STD INSTALLATION ONLY
FOR SPECIAL INSTALLATION ONLY
FOR STD INSTALLATION ONLY
FOR SPECIAL INSTALLATION ONLY
PWD
STBD RUDDER CONTROL
PORT RUDDER CONTROL
UP ELEVATOR CONTROL
DOWN ELEVATOR CONTROL
TO TOP RUDDER - STBD SIDE
TO BOTTOM RUDDER - STBD SIDE
TO STBD ELEVATOR TOP SIDE
TO STBD ELEVATOR BOTTOM SIDE
TO PORT ELEVATOR TOP SIDE
TO PORT ELEVATOR BOTTOM SIDE
TO BOTTOM RUDDER PORT SIDE
TO TOP RUDDER PORT SIDE
DIAGRAMATIC LAYOUT OF ELEVATOR AND RUDDER CONTROLS - CABLES IN NEUTRAL POSITION
PLAN VIEW

FIG. LIV
MAJOR CONTROLS
EMPENNAGE

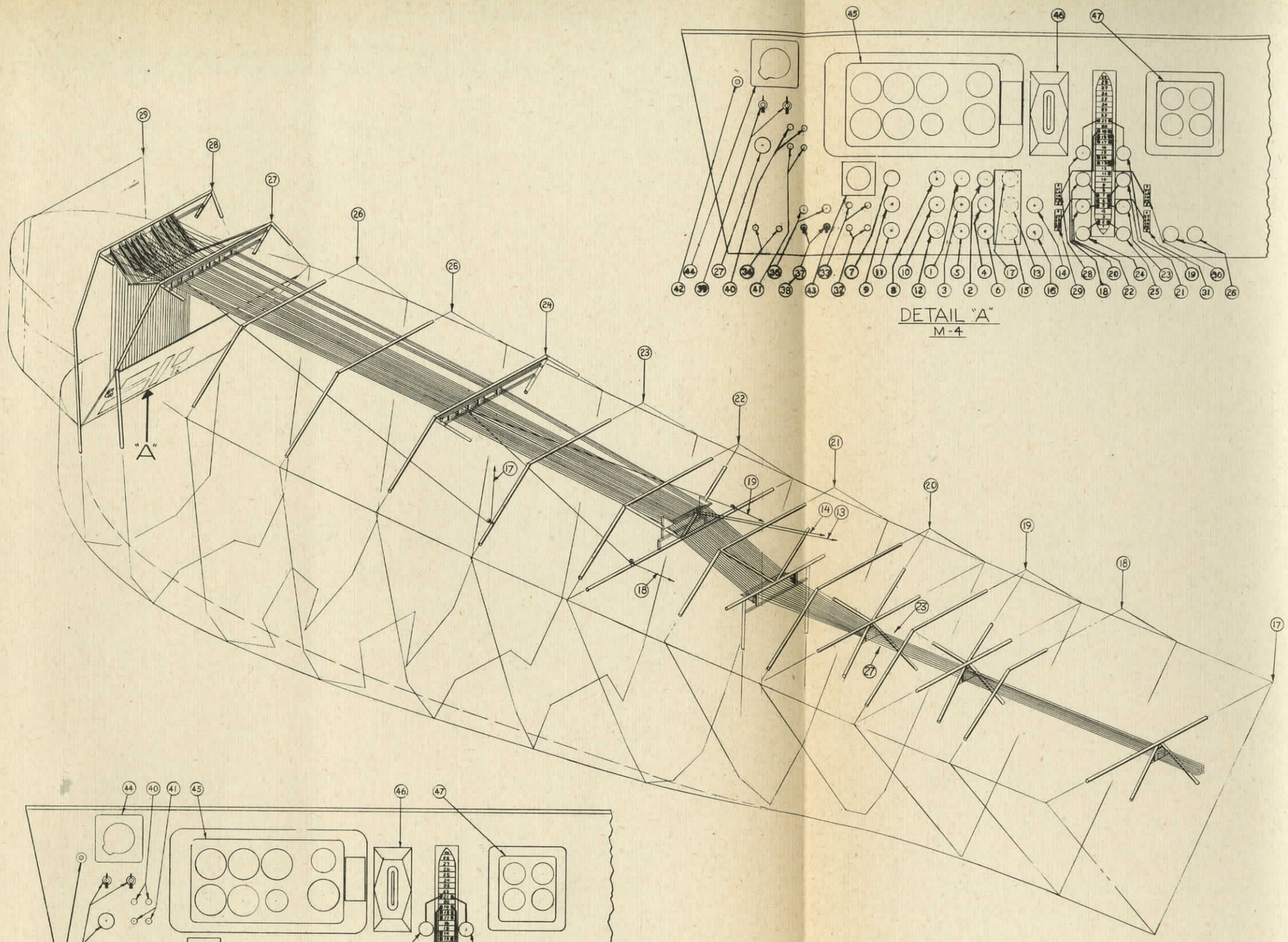
W. MINOR CONTROLS

The minor control system consists of the devices listed and illustrated in Fig. LV, items 1 through 31. They are cable actuated and equipped with exerciser cord tension devices. The cables are (7 x 7) 3/32-inch diameter, steel aircraft cable, and terminate in toggle knobs on the instrument panel. The six damper controls are equipped with a cable bead for locking in an open position. The three helium valve opening knobs are shielded by a hinged metal cover to prevent unintentional release. (Only two knobs are shielded on M-1, M-2 and M-3).

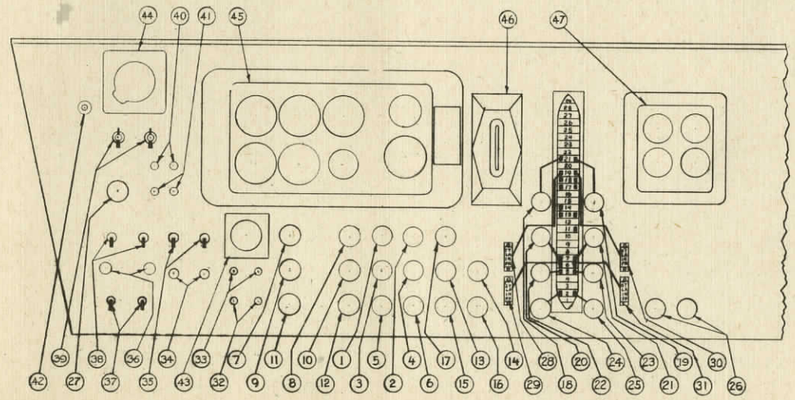
In addition to the above, a toggle knob located under the mechanic's chair between frames 12 and 13, controls the release latch for the main entrance door and ladder.

Ball bearing Micarta pulleys are used throughout except for the six aluminum alloy pulleys of the air damper valve system located just forward of frame 23.

Items 32 through 41 are electrical controls, and are included in this section for reference only. For further details on these and other controls, refer to "Instrument Panel", "Hydraulic", "Electrical", and "Armament" sections.



DETAIL "A"
M-4



DETAIL "A"
M-1, M-2, M-3

FIG. LV - MINOR CONTROLS - FORWARD CAR SECTION

NOMENCLATURE FOR THE THREE MINOR CONTROL DRAWINGS

1.	Forward Ballonet - Open	Air Valves
2.	Forward Ballonet - Close	
3.	Mid Ballonet - Open	
4.	Mid Ballonet - Close	
5.	Aft Ballonet - Open	
6.	Aft Ballonet - Close	
7.	Forward Ballonet - Port	Damper Valves
8.	Forward Ballonet - Starboard	
9.	Mid Ballonet - Port	
10.	Mid Ballonet - Starboard	
11.	Aft Ballonet - Port	
12.	Aft Ballonet - Starboard	
13.	Forward Helium - Open	Helium Valves
14.	Forward Helium - Close	
15.	Aft Helium - Open	
16.	Aft Helium - Close	
17.	Helium Valve - Emergency	
18.	Ballast	Dump Tanks
19.	Ballast	
20.	Fuel	
21.	Fuel	
22.	Fuel	
23.	Fuel	
24.	Ballast	
25.	Ballast	
26.	Handling Lines	
27.	Safety Switch	
28.	Slip Tank	
29.	Slip Tank	
30.	Slip Tank	
31.	Slip Tank	
32.	Auxiliary Air Blower Switches	
33.	Air Scoop Switches	
34.	Propeller Circuit Breakers	
35.	Propeller - Port - Feather	
36.	Warning Lights	
37.	Propeller - Port - Return from Reverse*	
38.	Propeller - Port Reverse*	
39.	Ultra Violet Light Switches	
40.	Magneto Switches - Generators	
41.	Magneto Switches - Main Engines	
42.	Helium Purity Meter Outlet	
43.	Air Scoop Indicator	
44.	Mid Ballonet Fullness Indicator	
45.	Instrument Sub-Panel	
46.	Pitch Indicator	
47.	Ballast Tank Gages	

* Note: On M-4 and Future, Items 37 and 38, which formerly consisted of four S.P.S.T. switches, were replaced by two D.P.D.T. switches.

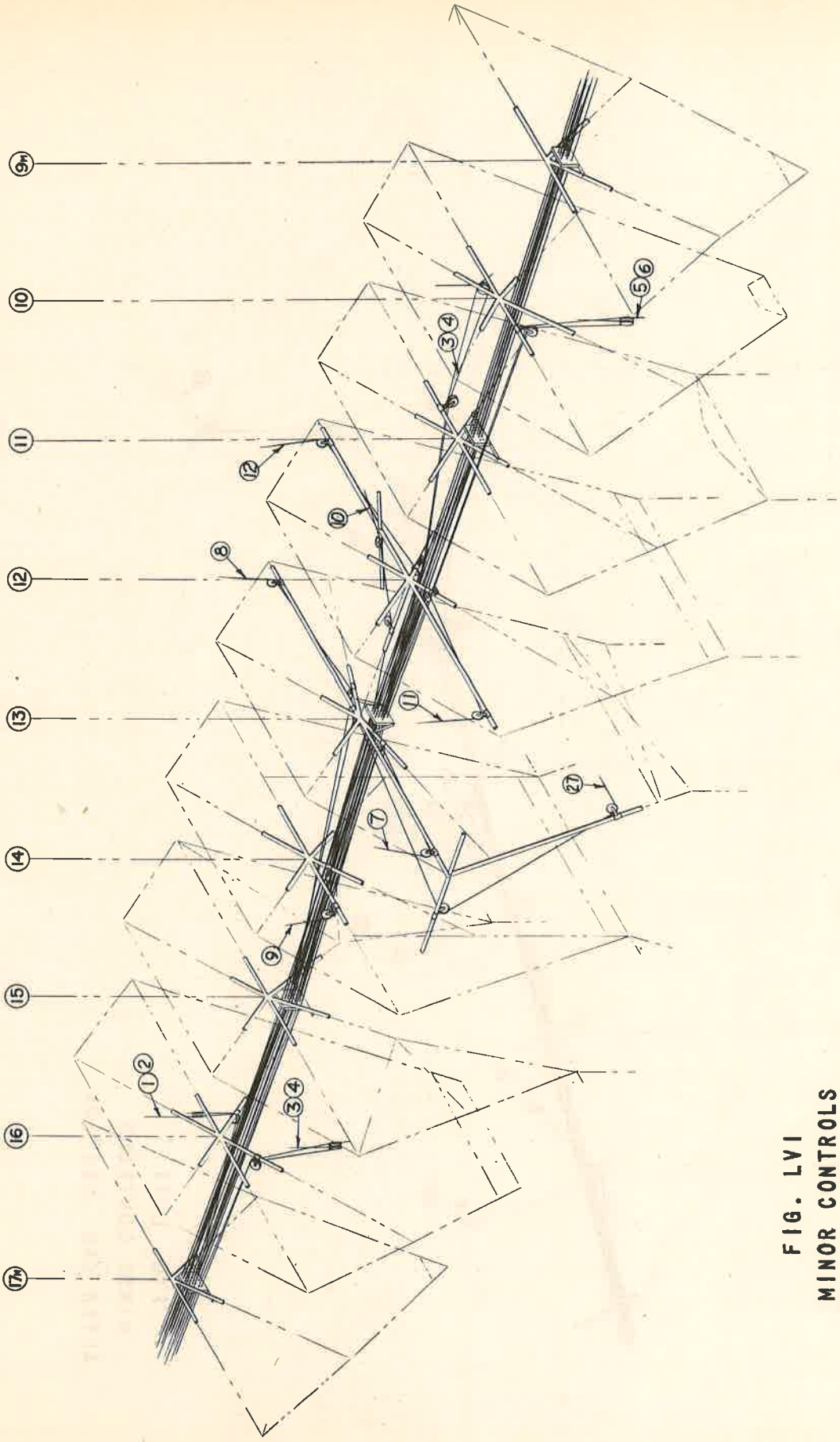


FIG. LVI
MINOR CONTROLS
MIDDLE CAR SECTION

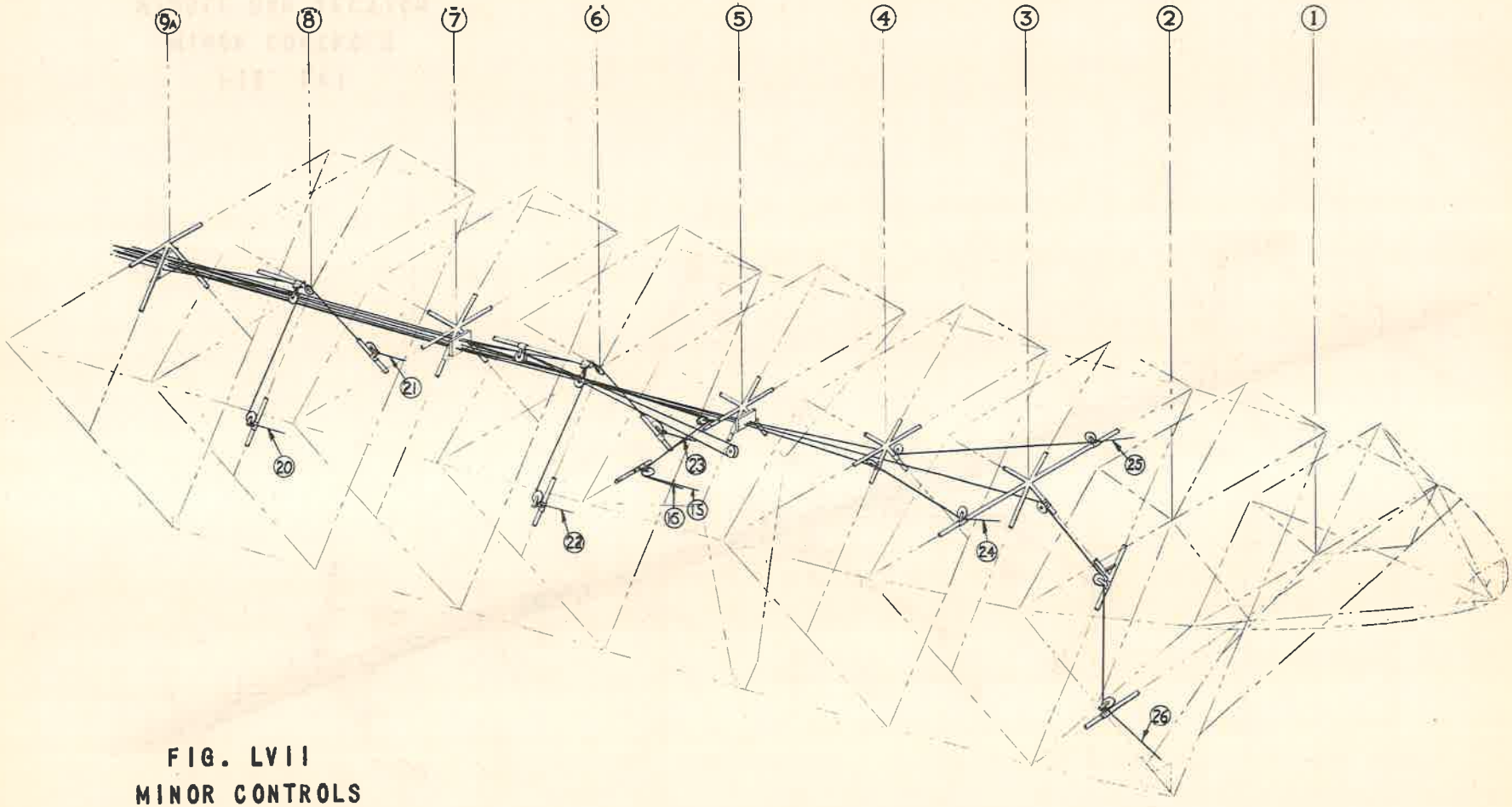


FIG. LVII
MINOR CONTROLS
AFTER CAR SECTION

X. HYDRAULIC SYSTEM

The following equipment is hydraulically operated:

	EQUIPMENT	TYPE OF CONTROL AND LOCATION
1.	Outrigger Air Scoops	Electrically operated solenoid valves - Pilot's instrument panel.
2.	Fwd. and After Bomb Bay Doors	Electrically operated solenoid valves - Bombardier's compartment.
3.	Fwd. Auxiliary Landing Wheel retraction mechanism	Manual Selector Valve - Aft side frame #26 starboard side.
4.	Main Landing Wheel retraction mechanism	Manual selector valve - Mechanic's hydraulic control panel.
5.	Main Access Ladder retraction mechanism	Manual selector valve - Mechanic's hydraulic control panel
6.	After Doors	Manual selector valve - Fwd. side frame #2, starboard side.
7.	Radar Beehive Unit	Manual selector valve - Mechanic's hydraulic control panel.

A 24-volt DC 6000 RPM electrically driven pump (Pesco Model IE-711-B) automatically operated by a pressure switch #578 provides an operating pressure of approximately 1000 lbs./sq.in. A 1.5-cu.in. per cycle emergency hand pump (Pesco IH-437-K), a 1.75 gallon reservoir, an accumulator (Pesco IA-438), a filter (Purolator 30017), and the necessary valves, fittings and tubing complete the system.

All tube fittings are AN type, the majority being straight thread type. The tubing is 52SO aluminum alloy 1/8, 1/4 and 3/8-inch O.D. with a minimum yield point of 4000 p.s.i. and a minimum bursting point of 8400 p.s.i. Flexible hose with detachable connections per AN-6260 is employed between car sections, to all cylinders and to the pump.

Thermal relief valves are provided for each hydraulic line.

Sectionalization valves are provided at the mechanic's station to isolate any of the three car sections. All control valves are hand operated excepting the air scoop and bomb bay door valves which are remotely operated by electric solenoid valves controlled from the pilot's and bombardier's compartments, respectively.

Safety valves have been provided in the bomb bay door circuits to insure armament workers against injury due to accidental door operation.

Emergency opening valves permit the bomb bay doors, the nose wheel and the main landing wheel to be opened and extended by gravity should the hydraulic power fail.

Valves are as follows:

4 - Solenoid Valves
6 - Check Valves
1 - Relief Valve
11 - Hand Shut-off Valves for M-1
12 - " " " " " M-2
13 - " " " " " M-3 and M-4
12 - Thermal Relief Valves
5 - Adjustable Restrictors
1 - 4-bank 4-way Valve
3 - 4-way Valves

Hydraulic Actuating cylinder data is as follows:

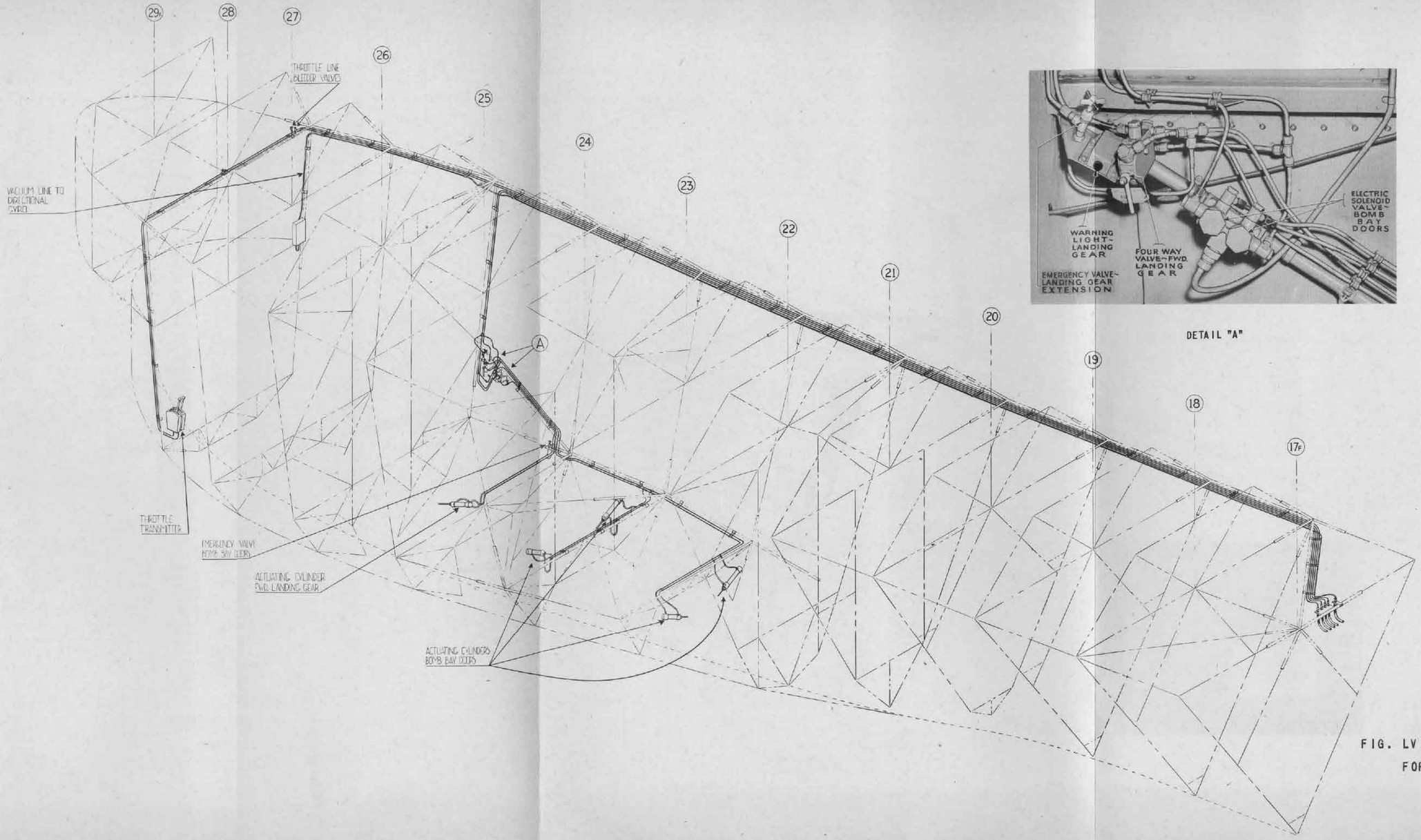
CYLINDERS	STROKE	GAC INST.DWG.
Nose Wheel (1) 287480 Weatherhead	12"	6090-120
Fwd. Bomb Bay (4) VS-11645 Vought Dwg.	6-3/16"	6090-1247
Main Wheel (1) 10455-1 Bendix	9-1/8"	6090-121
Door & Ladder (1) 287485 Weatherhead	7-7/8"	6090-5200
Radar (1) 287495 Weatherhead	5-3/4"	6090-1467
Air Scoops (2) 3090-726 GAC Dwg.	4"	6090-855
Aft Bomb Bay (2) 287485 Weatherhead	7-7/8"	6090-6098
Rear Doors (2) 287485 Weatherhead	7-7/8	6090-800

General Hydraulic installation drawings are as follows:

	M-1	M-2	M-3 & M-4
Forward Car	6090-139	6090-139	6090-7393
Middle Car	-140	-140	-7392
After Car	-141	-7391	-7391
*Control Panel	-1211	-1211	-7390

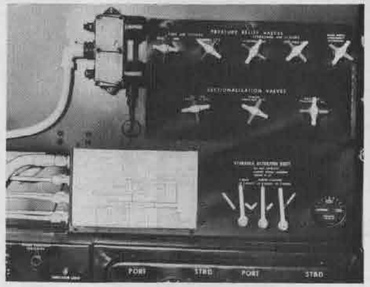
* For general description and data refer to section on instrument panels.

The throttle controls are also hydraulically operated but consist of an entirely separate system. (See engine controls).



DETAIL "A"

FIG. LVIII - HYDRAULIC SYSTEM
FORWARD CAR SECTION



DETAIL 'A'

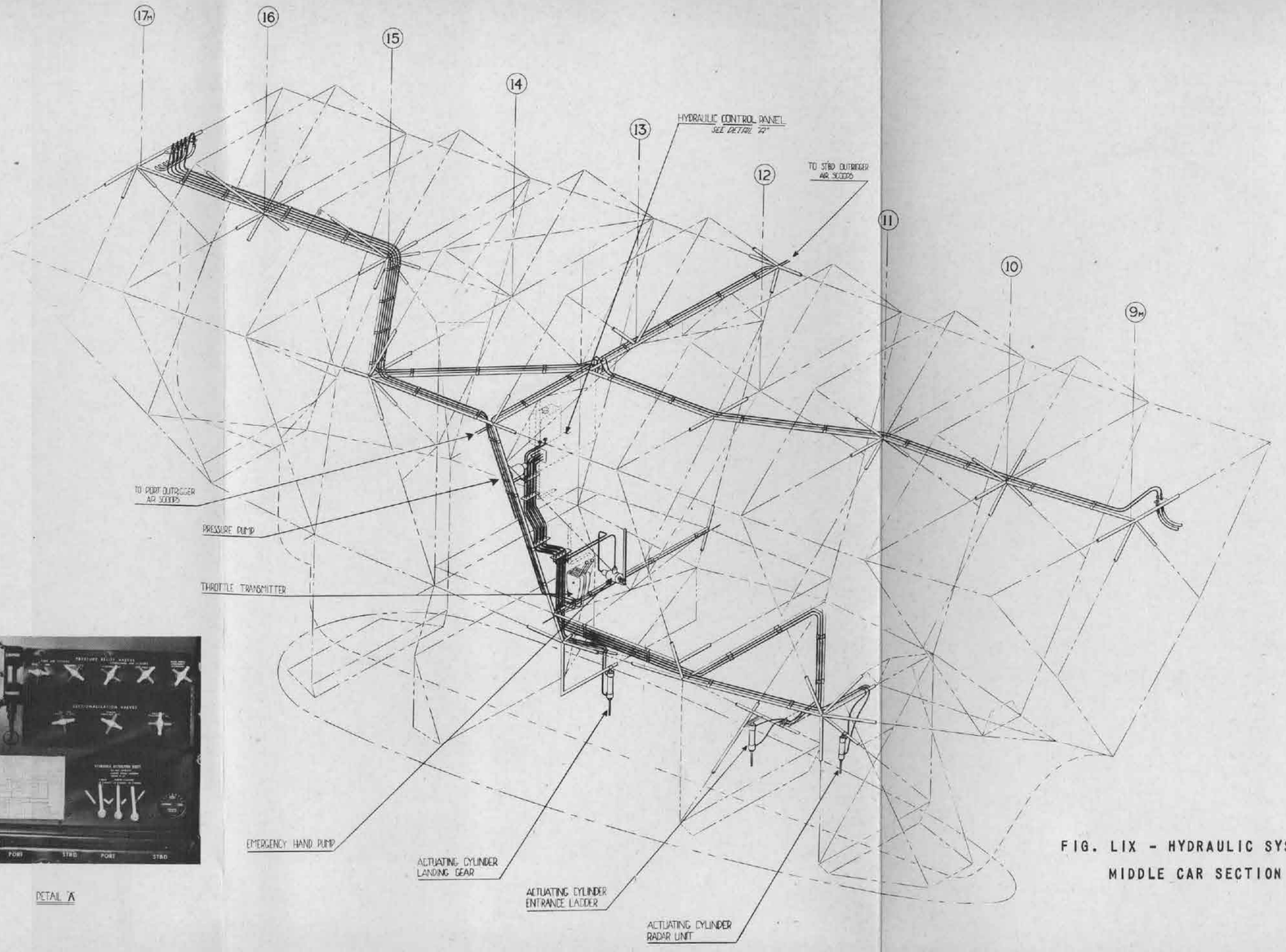


FIG. LIX - HYDRAULIC SYSTEM
MIDDLE CAR SECTION

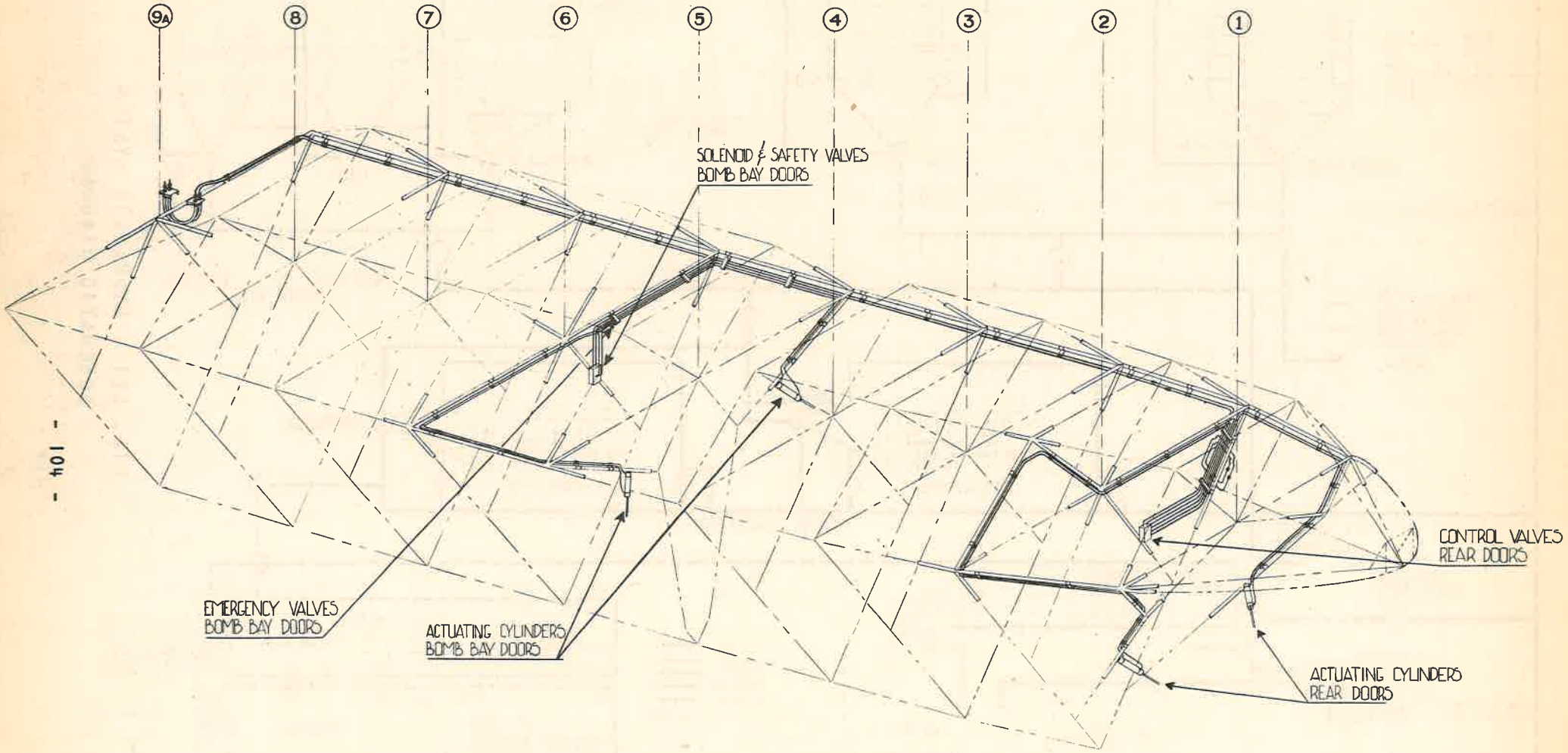


FIG. LX
HYDRAULIC SYSTEM
AFTER CAR SECTION

NOTE:
EXTENSION & RETRACTION LINES, AND TERMINOLOGY APPLY TO OPERATION OF THE UNIT AND NOT NECESSARILY OF THE CYLINDER.

SYSTEM
OPERATES AS A 1000 P.S.I. SYSTEM

TUBING
1/8 O.D. .035 WALL 5230 ALLOY (TO PRESSURE SWITCH ONLY)
1/4 O.D. .035 WALL 5230 ALLOY (PRESS. LINE)
3/8 O.D. .035 WALL 5230 ALLOY (BOTH PUMPS & ACCUMULATOR LINES FWD CAR)

FLUID VOLUME
TOTAL TUBING VOLUME — 19.1
TOTAL CYLINDER VOLUMES (EXT.) — 134.9
ACCUMULATOR VOLUME (1000 PSI) — 25.7
RESERVOIR (CONDITION MIN) — 239.0
TOTAL — 612.7 in³

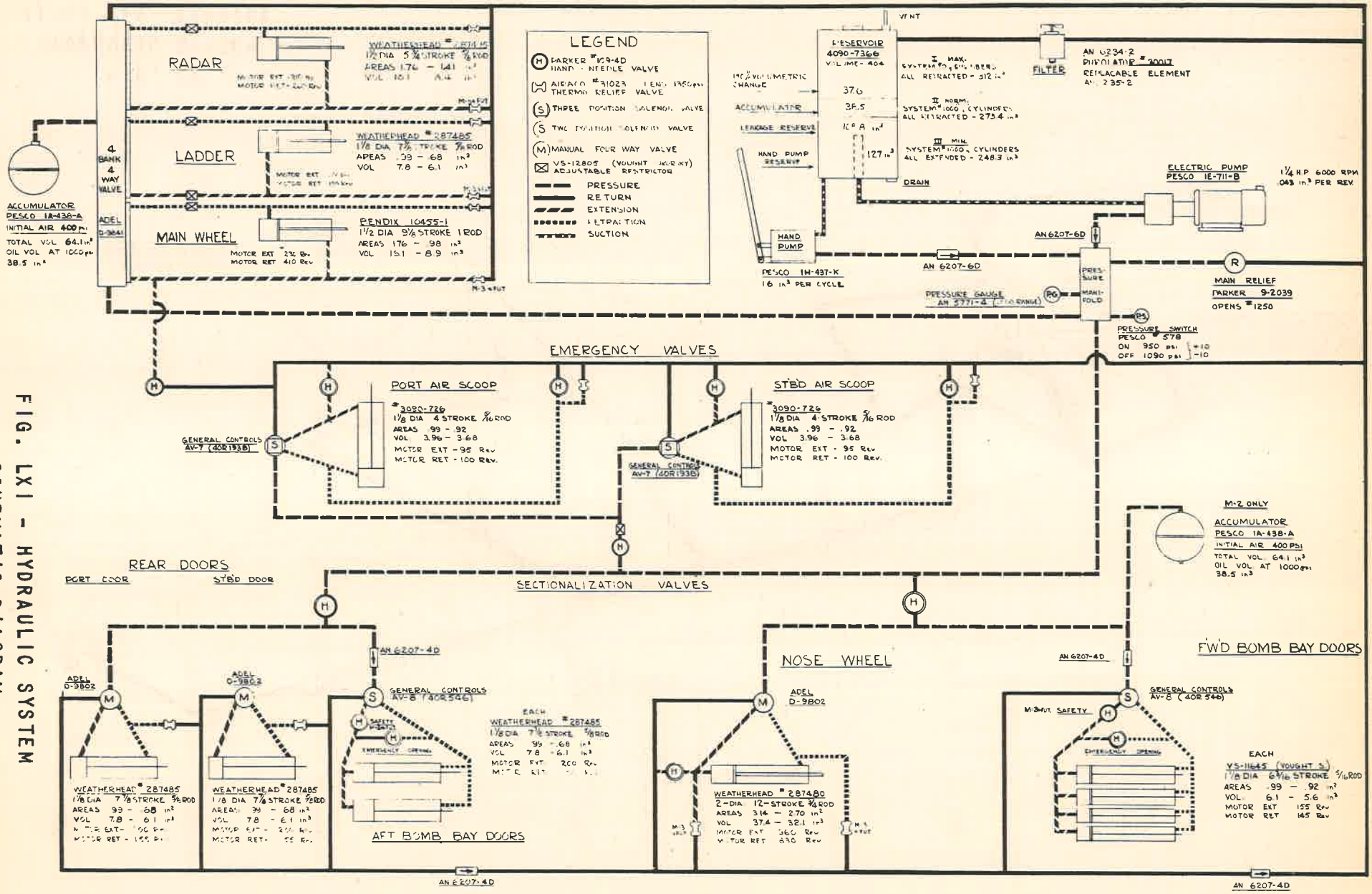


FIG. LX1 - HYDRAULIC SYSTEM SCHEMATIC DIAGRAM

Y. ELECTRICAL SYSTEM

The electrical system of the M-type airship consists of all the permanently installed electrical appliances and wiring on the airship; with the exception of the superheat meter system which has its own 22½-volt battery, and the immersion oil heaters which are equipped with separate "shore" connections.

A "shore" connection is also located inside the blister entrance panel on the port side so that the entire system may be connected to any outside suitable 24-volt DC source of supply.

All system appliances and instruments are operated by 24-volt DC excepting the Radar unit which utilizes 120-volt, 800-cycle alternating current.

Two generators, each consisting of a two-cylinder, 15 H.P. Lawrance Model #30D-1, Navy type, gasoline engine equipped with a Navy Model #NEA-5 Eclipse generator, furnish the electric power for the airship. Each NEA-5 generator is rated as follows:

DC - 28.5-volts - 6000-watts
AC - 120-volts - 800-cycles - 1200 watts
Continuous rating: Full AC plus ½ DC Load.

The #1 generator is installed on the starboard side of the middle car at floor level between frames 12 and 13, and the #2 is installed on the port side of the blister at floor level forward of frame 14.

An instrument panel for the generator system (Dwg. 6090-5580) is mounted above the Lawrance generator unit at frame 13, on the starboard side of the mechanic's compartment (see Fig. XLIX). The two AC and two DC voltage regulators for control of the generator outputs are mounted directly above the instrument panel. (Dwg. 6090-5619).

A breaker panel box (Dwg. 6090-5583) is mounted on the after starboard side of frame #13 immediately above the #1 generator. Inside the box are mounted two reverse-current relays, type 3GTR72C1 for control of the generator outputs and two relay breakers, type D-7230. A S.P.S.T. shielded toggle switch and a 20-amp. breaker for the fuel pump (M-4 only), and a galley breaker are mounted on the exterior of the box on the inboard side. The box cover is so held by speed clips as to be quickly removable.

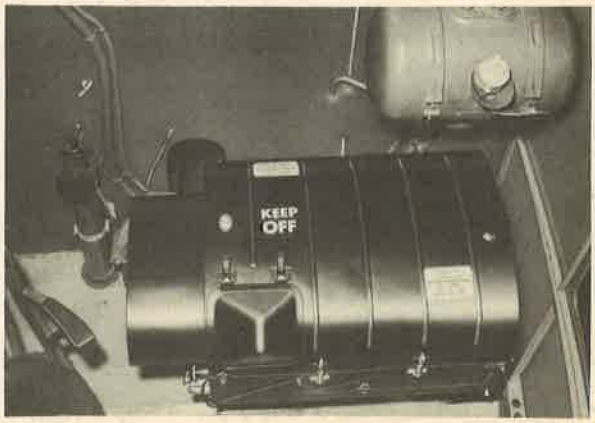


FIG. LXII - AUXILIARY GENERATOR

The battery system is composed of two Navy type NAF-1062-34, 12-volt batteries, rated at 34 ampere-hours each, connected in series to give a 24-volt system. This system provides an emergency source of 24-volt direct current when the auxiliary generators are not in operation. The batteries are located on the port side of the mid car, at floor level, forward of frame 13 (Dwg. 4090-143) and are vented to the outside of the car.

The battery output is controlled through the main junction box (Dwg. 4090-5588) which is located underneath the mechanic's panel at frame 13 and contains the master safety switch, the motor starter solenoid, the battery circuit-breaker and the two IFF breakers.

Other unit circuit-breakers and control switches are located on their appropriate instrument panels.

Dome lights are installed at the car ceiling at frames 13, 16, 25, and 27. Ultra-violet "black lights" are installed at all major instrument panels. A retractable landing light is installed in the bottom of the car at frame 28 and a spotlight is mounted on the starboard side of frame 28 at the rudder pilot's position. For location of the navigational lights, refer to "Bonding and Lighting" section.

The main electrical consumer loads are as follows:

(a) Two, 1000-watt surface elements in galley cooking range.
(b) Two, 2-H.P. electric motors for driving the two LaDel blowers of the air pressure system.
(c) One, 1-H.P. electric motor for operating the Pesco pump of the hydraulic system.
(d) One, 3/4-H.P. electric motor for driving the blower of the Stewart Warner Southwind heater unit.
(e) One, 1/4-H.P. electric motor for fuel pump (M-4 only)
(f) Special Navy furnished equipment: MAD, IFF, Interphone, Radar, Sondebuoy, and Radio.
(g) Propeller and hydraulic controls.
(h) Lighting system (car, instrument and navigational lights)

For more detailed information on the component parts of the electrical system, see the spare lamp data chart and the two electrical load analysis charts on the following pages.

SPARE LAMP DATA - M TYPE AIRSHIP

LOCATION	NO. REQ'D.	NAF NO.	TRADE NO.	LAMP TYPE	C.P.	VOLTS	BASE TYPE	BASE CONTACT	DRAWING NO.
Running Lights - Car	3	1068-19		S-8	27	28	Cand Bay	SC	3090-5443
Running Lights - Envelope	3		305	S-8	15	28	Cand Bay	SC	630-1616
Running Lights - Fins	3		305	S-8	15	28	Cand Bay	SC	2091-676
Nose Cone	1	1068-19		S-8	27	28	Cand Bay	SC	4092-373
Landing Lights (Grimes)	1		ST1220A	15	415	24	100 Hour		6090-83
Spot Light (Unity)	1		RP-11		0.9A	22	Pref. - flange	SC	6090-3
Signal Gun Light	1	1171-2		Par 46	5.5A	28	Grimes Sealed Beam		6090-3
Navigator's Light	1	1068-20	313	T-3¼	3	28	Min Bay	SC	3090-5571
Helium Valve Warning Lights	2	1068-20	313	T-3¼	3	28	Min Bay	SC	6090-125
Inclinometer 5°-0-5°	1	1068-20	313	T-3¼	3	28	Min Bay	SC	3079-5090
Flasher Light - Mech. Panel	1	1068-20	313	T-3¼	3	28	Min Bay	SC	6090-124
Propeller Lights NAF 1021	2	1068-19		S-8	27	28	Cand Bay	SC	3090-5600
Ultra Violet Lights - Pilot Panel	1	1192-9							6090-123
Ultra Violet Lights - Pilot Panel	2	1192-9							4090-1083
Ultra Violet Lights - Bombardier Panel	1	1192-9							6090-1326
Ultra Violet Lights - Mechanic Panel	1	1192-9							6090-124
Indicator - Landing Wheel Position	1	1068-20	313	T-3¼	3	28	Min Bay	SC	4090-1087
Indicator - Front Wheel Position	1	1068-20	313	T-3¼	3	28	Min Bay	SC	1090-5287
Elevator - Compass Light	0	Kollsman #71-900	For #2308 Light Ring (Not Connected)						
Pitch Indicator	1		1477	T-3	17A	28	Min Screw	SC	
Radio Table Light	1	1068-20	313	T-3¼	3	28	Min Bay	SC	2090-7264
Tel-Light (Pilot's) 110992	2	1068-20	313	T-3¼	3	28	Min Bay	SC	6090-123
Oil Warning Lights	2	1068-20	313	T-3¼	3	28	Min Bay	SC	6090-124
Tel-Light (Mech.) 110992	2	1068-20	313	T-3¼	3	28	Min Bay	SC	6090-124
Dome Lights - Frame 2	1		305	S-8	15	28	Cand Bay	SC	3090-5499
Dome Lights - Frame 8	1		305	S-8	15	28	Cand Bay	SC	3090-5500
Dome Lights - Frame 13	1		305	S-8	15	28	Cand Bay	SC	3090-5584
Dome Lights - Frame 16	1		305	S-8	15	28	Cand Bay	SC	3090-5585
Dome Lights - Frame 22	1		305	S-8	15	28	Cand Bay	SC	3090-5500
Dome Lights - Frame 25	1		305	S-8	15	28	Cand Bay	SC	3090-5500
Dome Lights - Frame 27	1		305	S-8	15	28	Cand Bay	SC	3090-5540
Indicator Lights - Bombardier Panel	12	1068-20	313	T-3¼	3	28	Min Bay	SC	6090-1326
Recall Light - Elev. Pilot	1	1068-20	313	T-3¼	3	28	Min Bay	SC	1090-5654
Recall Light - Rudder Pilot	1	1068-20	313	T-3¼	3	28	Min Bay	SC	1090-5655
Recall Light - Mechanic	1	1068-20	313	T-3¼	3	28	Min Bay	SC	2090-5659
Recall Light - Blister Observer	1	1068-20	313	T-3¼	3	28	Min Bay	SC	2090-5660
Recall Light - Aft Station	1	1068-20	313	T-3¼	3	28	Min Bay	SC	2090-5661
Recall Light - Radar Operator	1	1068-20	313	T-3¼	3	28	Min Bay	SC	2090-5662
Recall Light - Bombardier	1	1068-20	313	T-3¼	3	28	Min Bay	SC	2090-5663
Recall Light - Radio Operator	1	1068-20	313	T-3¼	3	28	Min Bay	SC	2090-5664
Recall Light - Machine Gunner	1	1068-20	313	T-3¼	3	28	Min Bay	SC	2090-5665
Recall Light - Navigator	1	1068-20	313	T-3¼	3	28	Min Bay	SC	2090-5666
Indicator Light - MBA	1	1068-20	313	T-3¼	3	28	Min Bay	SC	6090-5635
Indicator Light - Remote Meter (Pilot's)	1	1068-20	313	T-3¼	3	28	Min Bay	SC	4090-1078
Indicator Light - Remote Meter (Bombardier)	1	1068-20	313	T-3¼	3	28	Min Bay	SC	4090-1078

LAMP SUMMARY

Type	Req'd.
NAF 1068-19	6
NAF 1068-20	39
NAF-1192-9	5
NAF 1171-2	1
Trade No. 305	13
RP 11	1
1477	1
ST1220A Grimes	1
Total	67

RESTRICTED

GAC SK- 3-9551

ELECTRICAL LOAD ANALYSIS

OF

M-4 AIRSHIP CONTRACT NO. NOa(s)-146

LEGEND
C - CONTINOUS
M - MOMENTARY (5 MIN. OR LESS)
X - OFF
* - NAVY FURNISHED
** - DURATION OF FLIGHT

TYPE OF EQUIPMENT	MANUFACTURER & PART DESIGNATION	NO. OF UNITS	AMPERES PER UNIT	DURATION OF OPERATION	TYPE OF OPERATION (M OR C)	TOTAL AMPERE LOADING DURING OPER. NORMAL ANCHOR	NORMAL CRUISING	NIGHT CRUISING	BATTLE ACTION
POWER SOURCE & CONTROLS									
GENERATORS - OUTRIGGER	None								
CONTROL - BOX									
AUXILIARY - POWER UNIT	*Lawrance Aux. Power Plant #1E	2	*						
ENGINE	*Lawrance 300-1								
GENERATOR	*NEA-5	2	6KW Continuous DC load @ 30 Volts. 1.2KW Continuous AC load @ 120 volts 800 cycles						
CONTROL BOX									
RELAY - REV. CURRENT	*GE 36TR7201	2							
STARTER - CONTACTOR									
BATTERIES	*AN 3152	2	34 Ampere hour						
CONVERTERS									
DYNAMOTORS									
INVERTERS - COMPASS	*Pioneer Type 12117	1	1A @ 24V.	As Required	C	X	1.0	1.0	X
INVERTERS - ULTRA VIOLET									
A-PERSONNEL EQUIPMENT									
GRILL - STOVE - OVEN	Tappan Stove Co. Model SM-1000	1	81.2A @ 24 Volts	1-4 hours/day	C	X	81.2	81.2	81.2
PERCOLATOR									
ROASTERETTE									
TOASTER									
CAR HEATING & VENTILATION	Stewart-Warner - South Wind Heater, Driven by GE Motor, Model BC-21N, 3/4 hp	1	1A @ 24V.	**When needed	C	X	1.0	1.0	1.0
			29.9A @ 24V.	**When needed	C	X	29.9	29.9	29.9
	Stewart-Warner Heater Starting		11.0A @ 24V.	**When needed	M	X	11.0	11.0	11.0
B-ARMAMENT									
BOMB-DOOR	Borg-Warner AV-8 Solenoid Valve	2	1-1/2A @ 24V.	See note #1 - as req'd	M	3.0	X	X	3.0
BOMB - HOIST									
BOMB - SIGHT									
BOMB-ARMING	*Mark 51 Model 7	16	1.2A @ 24V.	As Required	M	X	X	X	19.2
BOMB - RELEASE	**Mark 51 Model 7	8	4.8A @ 24V.	See note #2 - as req'd	M	X	X	X	4.3
GUN SIGHT-ILLUMINATED									
IND. LIGHTS-BOMB Arming	Grimes Mfg. Co. #A2328	2	0.17A @ 24V.	As Required	M	X	X	X	0.34
IND. LIGHTS - BOMB DOOR	Grimes Mfg. Co. #A2328	2	0.17A @ 24V.	See note #1 - as req'd	M	0.34	X	X	0.34
IND. LIGHTS - BOMB RELEASE	Grimes Mfg. Co. #A2328	8	0.17A @ 24V.	See note #1 - as req'd	M	X	X	X	1.36
SOUNDEBUOY									
Note #1 Current on when doors are open.									
Note #2 Instantaneous - Released in sequence.									
Note #3 Burn till bomb is released.									
C-ENGINE									
HEATER - OIL SERVICE TANK	S.L. Viscand Co. Navy type C	2	1 KW - 120 V.	(shore connection)					
HEATER - AUXILIARY UNIT	*Furnished with Lawrance units	2	10A @ 24V.	As Required	C	X	20.0	20.0	20.0
HEATER - ENGINE									
STARTER	*Eclipse, Series 11, Type 429, Model 3	2	300 A @ 24V.	(while starting engines)	M				
STARTER - SOLENOID SWITCH	*Eclipse, Type 518, Model 2	2		(while starting engines)	M				
MESHING - SOLENOID DEVICE	*Eclipse, Type 530, Model 4	2		(while starting engines)	M				
BOOSTER COIL	*Eclipse, Type 511, Model 7	2	1.0A @ 24V.	(while starting engines)	M				
TRANSFER PUMPS - FUEL	Hleg. Specialty Co. Type MGA23	1	12.4A @ 24V.	Fuel Transfer	C	12.4	12.4	12.4	X
TRANSFER PUMPS - OIL									
PROPELLER - PITCH CONTROL	*Curtiss Electric Propeller)	2	13.5A @ 24V.	See note #4)	M	X	27.0	27.0	27.0
PROPELLER - FEATHERING	*Model 0532 S)	2	13.5A @ 24V.	See note #4)					
PROPELLER - SYNCHRONIZER									
Note #4 - Same motor used for pitch control and feathering.									
D-HANDLING & OPERATING									
AIR PRESSURE SYSTEM	LaDel Blower (Emerson 2 hp motor)	2	87.0A @ 27.5V.	For hovering or landing only	C	170.00	170.00	170.00	170.00
AIR SCOOP SOLENOID VALVE	General Control - AV 7	2	1.0A @ 24V.	Intermittent	M	X	2.0	2.0	2.0
PITOT HEATER									
HYDRAULIC SYSTEM - MOTOR	Pesco #711A Unit (1.25 hp motor)	1	As Max. A @ 24V	Intermittent	M	66.0	66.0	66.0	66.0
HYDRAULIC SYSTEM - RELAY	Square "D" J-6	1	1.0A @ 24V.	Intermittent	M	1.0	1.0	1.0	1.0
HYDRAULIC SYSTEM - SOLENOID	Davis - Model 2000	2	2.0A @ 24V.	Intermittent	M	4.0	4.0	4.0	4.0
RELEASE - SLIP TANKS	Mark 3 Model 2 and 3	4	4.8A @ 24V.	Released in sequence	M	X	X	X	4.8
RETRACTABLE LANDING GEAR									
IGNITION - AUX. BLOWER									
E-LIGHTING									
LANDING LIGHT	Grimes Mfg. Co. #ST 1220A	1	10.0A @ 24V.	Night landing only	C	X	X	10.0	X
SPOTLIGHT									
RUNNING LIGHTS - CAR	MAP1021 per GAC Dwg #3020-5443	3	0.6A @ 28V.	Night operation only	C	X	X	1.8	1.8
RUNNING LIGHTS - ENVELOPE	GAC See note #5	7	0.6A @ 23V.	Night operation only	C	X	X	4.2	4.2
INDICATOR LIGHTS	Grimes #A2328	10	0.17A @ 28V.	As Required	C	X	1.7	1.7	1.7
SIGNAL LIGHT	Grimes K-1, MAF 1.71-2	1	5.3A @ 24V.	As Required	M	5.3	5.3	5.3	5.3
CAR LIGHTING	GAC Dr. . #3079-1031	6	0.6A @ 24V.	As Required	C	3.6	3.6	3.6	3.6
NAVIGATOR'S LIGHT	GAC	1	0.2A @ 24V.	As Required	C	0.2	0.2	0.2	0.2
RADIO TABLE LIGHT	GAC	1	0.2A @ 24V.	As Required	C	0.2	0.2	0.2	0.2
PANEL - INCANDESCENT									
PANEL - ULTRA VIOLET	MIP 1192-1	4	0.2A @ 24V.	As Required	C	0.8	0.8	0.8	0.8
Note #5 GAC Dwgs. No 610-1616, 3091-676, 61071-796									
F-RADIO									
MAIN TRANSMITTER	*Collins - Mode. ATC	1	16.7A @ 28V.	As Required	C	16.7	16.7	16.7	16.7
TRANSMIT	Model ATC	1	16.7A @ 28V	As Required					
STANDBY	Model ATC	1	11.0A @ 28V	**					
MAIN RECEIVER	*RCA Model ARB	1	2.4AD 28V	** See note #6	C	2.4	2.4	2.4	2.4
INTRA-SQUAD TRANSMITTER	*RCA Model 77B	1	14.4A @ 28V	See note #6	C	14.4	14.4	14.4	14.4
TRANSMIT		1	12.0A @ 28V	**					
STANDBY		1	10.0A @ 28V	**					
INTRA-SQUAD RECEIVER	*RCA - Model ARB	1	2.4A @ 28V						
MARKER BEACON RECEIVER	*Airtronk Mfg. Corp. MRA	1	Specification not received						
INTERPHONE	*Magnavox - RL 24G	1	2.5A @ 24V	**	C	2.5	2.5	2.5	2.5
RADAR	* ASG-2	1	8.0A @ 24V DC 6.9A @ 120V AC	**	C	8.0DC 6.9AC	8.0DC 6.9AC	8.0DC 6.9AC	8.0DC 6.9AC
DIRECTION FINDER	*RCA ARB Receiver	1	2.4A @ 28V.	See note #6	C	X	2.4	2.4	2.4
FREQUENCY INDICATOR	*Bendix Radio - LM-10	1	1-1/4A @ 28V	As Required	M	1.25	1.25	1.25	1.25
HOMING EQUIPMENT	* RB-1	1	1-1/4A @ 28V	See note #7	M	X	1.25	1.25	1.25
I.F.F. SYSTEM	* AMK	1	5.5A @ 28V.	**See note #8	C	X	5.5	5.5	5.5
M.A.D. SYSTEM	* Mark 4-B2	1	15AD 24V.	**	C	X	15.0	15.0	15.0
MISC. RADIO EQUIPMENT									
Note #6 Switching motor requires 4 amperes more - very short interval.									
Note #7 Use ZB-1 (Western Electric) until ZBX (Bell Telephone Lab) is available.									
Note #8 Use ARK until ABJ is available.									
G-MISCELLANEOUS									
MAPPING CAMERA									
INSTRUMENTS	Operating Current	Lot	6A @ 28.5V	**	C	X	5.0	5.0	5.0
REMARKS	Total generator capacity is 400 amperes DC			TOTAL CONTINUOUS LOAD		252.2	419.9	435.9	413.0
				ADDITIONAL MOMENTARY LOAD		91.9	118.8	118.8	152.6
				TOTAL LOAD		344.1	538.7	554.7	564.6

RESTRICTED

GAC SK-5-9553

ELECTRICAL LOAD ANALYSIS

OF

M-3 AIRSHIP CONTRACT NO. NOa(s)-146

LEGEND
C - CONTINOUS
M - MOMENTARY (5 MIN. OR LESS)
X - OFF
* - NAVY FURNISHED
** - DURATION OF FLIGHT

TYPE OF EQUIPMENT	MANUFACTURER & PART DESIGNATION	NO. OF UNITS	AMPERES PER UNIT	DURATION OF OPERATION	TYPE OF OPERATION (M OR C)	TOTAL AMPERE LOADING DURING OPER. NORMAL ANCHOR	NORMAL CRUISING	NIGHT CRUISING	BATTLE ACTION
POWER SOURCE & CONTROLS									
GENERATORS - OUTRIGGER	None								
CONTROL - BOX									
AUXILIARY - POWER UNIT	*Lawrance Aux. Power Plant #18	2							
ENGINE	*Lawrance 30D-1		6 HW Continuous DC load @ 30 volts						
GENERATOR	*NSA-5	2	1.2 KW Continuous AC load @ 120 volts 800 cycles						
CONTROL BOX									
RELAY - REV. CURRENT	*GE 3GTR7201	2							
STARTER - CONTACTOR									
BATTERIES	*AN 3152	2	34 ampere hour						
CONVERTERS									
DYNAMOTORS									
INVERTERS - COMPASS	*Pioneer Type 12117	1	1A @ 24V.	As Required	C	X	1.0	1.0	X
INVERTERS - ULTRA VIOLET									
A-PERSONNEL EQUIPMENT									
GRILL - STOVE - OVEN	Tappan Stove Co. Model SM-1000	1	83.2A @ 24V.	3-4 hours/day	C	X	83.2	83.2	83.2
PERCOLATOR									
ROASTERETTE									
TOASTER									
CAR HEATING & VENTILATION	Stewart-Warner - South Wind								
	Heater, driven by		1A @ 24V.	**When needed	C	-X	1.0	1.0	1.0
	GE Motor, Model BC-21M, 3/4 HP	1	29.9A @ 24V.	**When needed	C	X	29.9	29.9	29.9
	Stewart-Warner Heater Starting		11.0A @ 24V.	**When needed	M	X	11.0	11.0	11.0
B-ARMAMENT									
BOMB - DOOR	Borg-Warner AY-8 Solenoid Valve	2	1-$\frac{1}{2}$A @ 24V.	See note #1 - as req'd	M	3.0	X	X	3.0
BOMB - HOIST									
BOMB - SIGHT									
BOMB - ARMING	*Mark 51 Model 7	16	1.2A @ 24V.	As Required	M	X	X	X	19.2
BOMB - RELEASE	*Mark 51 Model 7	8	4.8A @ 24V.	See note #2 - as req'd	M	X	X	X	4.3
GUN SIGHT - ILLUMINATED									
IND. LIGHTS - BOMB	Grimes Mfg. Co. #A2328	2	0.17A @ 24V.	As Required	M	X	X	X	0.34
IND. LIGHTS - BOMB DOOR	Grimes Mfg. Co. #A2328	2	0.17A @ 24V.	See note #1 - as req'd	M	0.34	X	X	0.34
IND. LIGHTS - BOMB RELEASE	Grimes Mfg. Co. #A2328	8	0.17A @ 24V.	See note #3 - as req'd	M	X	X	X	1.36
SOUNDEBUOY									
Note #1 - Current on when doors are open.									
Note #2 - Instantaneous - Released in sequence.									
Note #3 - Burn till bomb is released.									
C-ENGINE									
HEATER - OIL SERVICE TANK	E.L. Wiegand Co. Navy Type C	2	1 KW - 120V.	(Shore connection)					
HEATER - AUXILIARY UNIT	*Furnished with Lawrance units	2	10A @ 24V.	As Required	C	X	20.0	20.0	20.0
HEATER - ENGINE									
STARTER	*Eclipse, Series 11, Type 429, Model 3	2	300A @ 24V.	(While starting engines)	M				
STARTER - SOLENOID SWITCH	*Eclipse, Type 518, Model 2	2		(While starting engines)	M				
MESHING - SOLENOID DEVICE	*Eclipse - Type 500, Model 4	2		(While starting engines)	M				
BOOSTER COIL	*Eclipse - Type 513, Model 7	2	1.0A @ 24V.	(While starting engines)	M				
TRANSFER PUMPS - FUEL									
TRANSFER PUMPS - OIL									
PROPELLER - PITCH CONTROL	*Curtiss Electric Propeller)	2	13.5A @ 24V.	See note #4)	M	X	27.0	27.0	27.0
PROPELLER - FEATHERING	*Model C432 E)	2	13.5A @ 24V.	See note #4)					
PROPELLER - SYNCHRONIZER									
Note #4 - Same motor used for pitch control and feathering.									
D-HANDLING & OPERATING									
AIR PRESSURE SYSTEM	LaPal Blower (Kearsarge 2HP Motor)	2	85.0A @ 27.5V	For hovering or landing only	C	170.00	170.00	170.00	170.00
AIR SCOOP SOLENOID VALVE	General Control - AV-7	2	1.0A @ 24V.	Intermittent	M	X	2.0	2.0	2.0
PITOT HEATER									
HYDRAULIC SYSTEM - MOTOR	Pesco 7711A Unit (1.25 HP motor)	1	66 Max.A @ 24V	Intermittent	M	66.0	66.0	66.0	66.0
HYDRAULIC SYSTEM - RELAY	Square "D" J-6	1	1.0A @ 24V	Intermittent	M	1.0	1.0	1.0	1.0
HYDRAULIC SYSTEM - SOLENOID	Davis - Model 2000	2	2.0A @ 24V	Intermittent	M	4.0	4.0	4.0	4.0
RELEASE - SLIP TANKS	Mark 3 Model 3 and 3	4	4.8A @ 24V	Released in sequence	M	X	X	X	4.8
RETRACTABLE LANDING GEAR									
IGNITION - AUX. BLOWER									
E-LIGHTING									
LANDING LIGHT	Grimes Mfg. Co. #ST 1200 A	1	10.0A @ 24V	Night landing only	C	X	X	10.0	X
SPOTLIGHT									
RUNNING LIGHTS - CAR	NAF 1091 per GAC Dwg 3090-5443	3	0.6A @ 28V	Night operation only	C	X	X	1.8	1.8
RUNNING LIGHTS - ENVELOPE	GAC See note #5	7	0.6A @ 28V	Night operation only	C	X	X	4.2	4.2
INDICATOR LIGHTS	Grimes #A2328	10	0.11A @ 28V	As Required	C	X	1.1	1.1	1.1
SIGNAL LIGHT	Grimes K-3, NAF 3171-2	1	5.3A @ 24V	As Required	M	5.3	5.3	5.3	5.3
CAR LIGHTING	GAC Dwg. 3079-1633	6	0.6A @ 24V	As Required	C	3.6	3.6	3.6	3.6
NAVIGATOR'S LIGHT	GAC	1	0.2A @ 24V	As Required	C	0.2	0.2	0.2	0.2
RADIO TABLE LIGHT	GAC	1	0.2A @ 24V	As Required	C	0.2	0.2	0.2	0.2
PANEL - INCANDESCENT									
PANEL - ULTRA VIOLET	NAF 2192-1	4	0.2A @ 24V.	As Required	C	0.8	0.8	0.8	0.8
Note #5 GAC Dwgs. No. 630-1616, 2091-796									
F-RADIO									
MAIN TRANSMITTER	*Collins - Model ATC	1	36.7A @ 28V	As Required	C	36.7	36.7	36.7	36.7
TRANSMIT	Model ATC	1	36.7A @ 28V	As Required					
STANDBY	Model ATC	1	31.0A @ 28V	**					
MAIN RECEIVER	*RCA Model ARB	1	2.4A @ 28V	** See note #6	C	2.4	2.4	2.4	2.4
INTRA-SQUAD TRANSMITTER	*RCA Model ATB	1	14.4A @ 28V	** See note #6	C	14.4	14.4	14.4	14.4
TRANSMIT		1	12.0A @ 28V	**					
STANDBY		1	10.0A @ 28V	**					
INTRA-SQUAD RECEIVER	*RCA - Model ARB	1	2.4A @ 28V						
MARKER BEACON RECEIVER	*Airtrack Mfr. Corp. MBA	1	Specification not received						
INTERPHONE	*Magnavox - ML 24C	1	2.5A @ 24V	**	C	2.5	2.5	2.5	2.5
RADAR	* ASG-2	1	9.0A @ 24V DC 6.9A @ 120 V AC	**	C	9.0DC 6.9AC	9.0DC 6.9AC	9.0DC 6.9AC	9.0DC 6.9AC
DIRECTION FINDER	*RCA ARB Receiver	1	2.4A @ 28V	See note #6	C	X	2.4	2.4	2.4
FREQUENCY INDICATOR	*Bendix Radio - LM-10	1	1-$\frac{1}{2}$ A @ 28V	As Required	M	1.25	1.25	1.25	1.25
HOMING EQUIPMENT	* ZB-3	1	1-$\frac{1}{2}$ A @ 28V	See note #7	M	X	1.25	1.25	1.25
I.F.F. SYSTEM	* ABK	1	5.5A @ 28V	**See note #8	C	X	5.5	5.5	5.5
M.A.D. SYSTEM	* Mark 4-B2	1	15A @ 24V.	**	C	X	15.0	15.0	15.0
MISC. RADIO EQUIPMENT									
Note #6 - Switching motor requires 4 amperes more - very short interval.									
Note #7 - Use ZB-3 (Western Electric) until ZBX (Bell Telephone Lab) is available.									
Note #8 - Use ABK until ABJ is available.									
G-MISCELLANEOUS									
MAPPING CAMERA									
INSTRUMENTS	Operating current	Lot	5A @ 28.5V	**	C	X	5.0	5.0	5.0
REMARKS Total generating capacity is 420 amperes per hr.				TOTAL CONTINUOUS LOAD		238.8	407.5	421.5	412.0
				ADDITIONAL MOMENTARY LOAD		91.9	118.8	118.8	152.6
				TOTAL LOAD		330.7	526.3	542.3	564.6

Z. RADIO AND INTERPHONE SYSTEMS

All radio equipment is furnished by the Navy Department. The following outline indicates the type of equipment and its location on the ship: (Dwg. 6090-152)

Command Radio:

ATB-Transmitter - located on radio table

ARB-Receiver - located on shelf over navigator's table

L-Antenna on envelope; receiver connected to transmitter

Controls at Pilot's position:

- ATB-Transmitter control
- ARB-Receiver tuning control
- ARB-Receiver control box
- Radio range filter located with controls

Main Radio:

ATC-Transmitter - located on radio table

ARB-Receiver - located on radio table

Loading coil, reel and antenna fairlead located under table

Controls of main radio:

- ATC-Controls on face of transmitter; radio operator use only.
- ARB-Receiver control box on starboard side near radio operator.

Navigation Radio:

ARB-Receiver (located on radio table) using a balanced T antenna for range reception and a nose-loop antenna for direction finding. (Both antennae on envelope)

Controls at co-pilot's position:

- ARB-Receiver tuning control
- ARB-Receiver control box
- Radio range filter located with controls

MBA-Receiver (fan marker)

- Located on Radio operator's table
- Balanced T antenna on starboard, forward, handrail
- Operates an indicator lamp on co-pilot's panel
- Audiotone output available to co-pilot via interphone circuits.

ZBX-Homing receiver located overhead at co-pilot's position. Tuning control and receiver control in control box at co-pilot's position. Removable post antenna on bottom of car in the vicinity of pilot's station.

Additional radio equipment:

ATC-Dynamotor located under radio table
ATB-Dynamotor located on radio table shelf
ARB-Dynamotors are self-contained in the receivers
ZBX-Dynamotor located on ZBX receiver
MBA-no dynamotor
Radio table (Goodyear furnished) Frame #25, starboard side

Interphone System (I.C.S.):

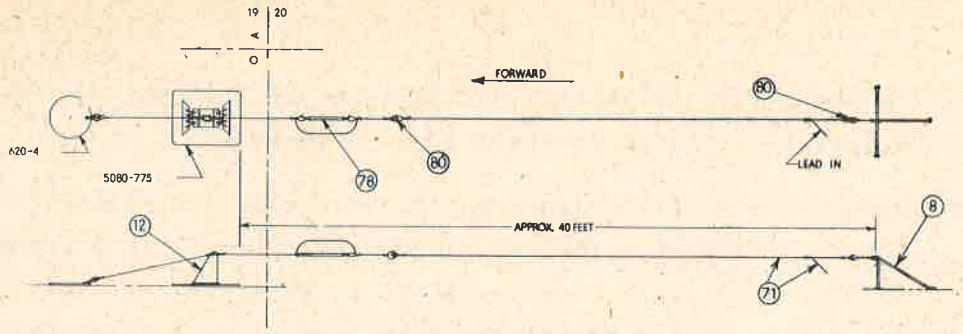
Modified RL-24C:

Seven Crew Stations; (1) Aft Station, (2) Mid-Observer, (3) Radar Operator, (4) Mechanic, (5) Machine Gunner, (6) Navigator, (7) Bombardier.

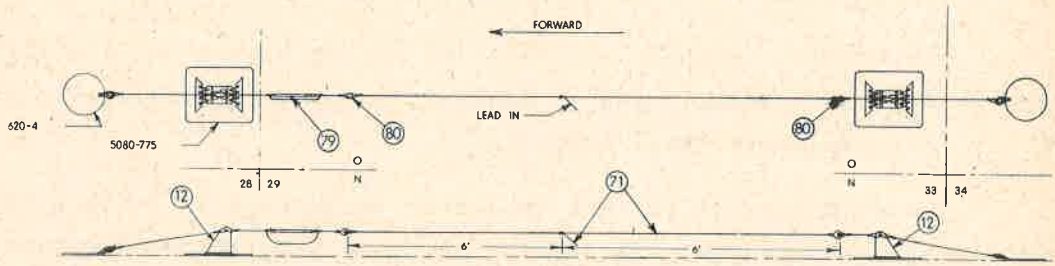
Three Mixing Panels: (1) Radio Operator, (2) Pilot, (3) Co-pilot.

The ten stations serve for interphone communication between all stations with an added feature of complete radio reception at any of the three mixing panels. RL-24C interphone control unit is located on a cradle above the radio table. All radio outputs are fed into the I.C.S. circuits for the three mixing panels.

The radio table (Dwg. 6090-1267), including a two-tier shelf, is constructed of aluminum alloy and mounted on the starboard side of the car at frame 25. The table top is of aluminum alloy covered with "Aeroflor" made by Armstrong Cork Company. A panel light, eight day clock, and a swivel chair are provided for the radio operator.



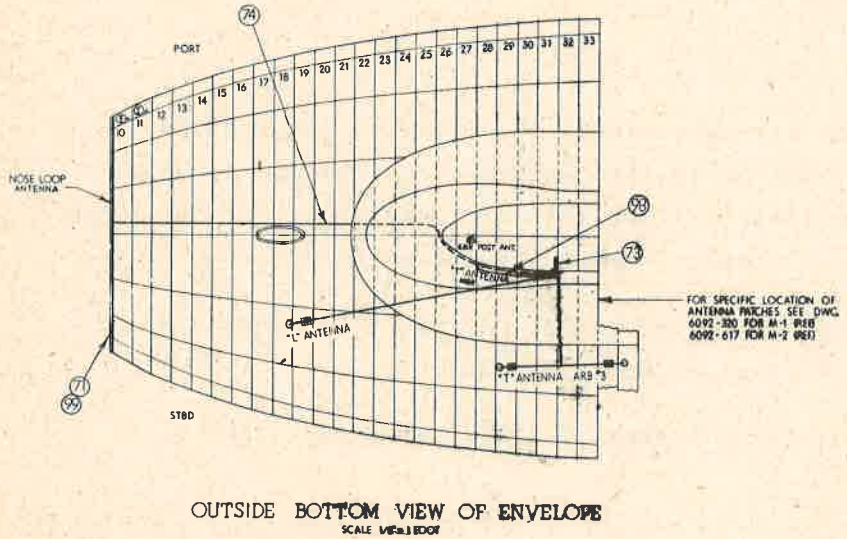
'L' ANTENNA LAYOUT
NO SCALE



'T' ANTENNA FOR ARB #3
NO SCALE

FIG. LXIII

ANTENNAE INSTALLATION



OUTSIDE BOTTOM VIEW OF ENVELOPE
SCALE 1/8" = 1 FOOT

NOMENCLATURE

8. Mast - Antenna
12. Bracket - Antenna
71. Cable - Antenna
73. Flexible Conc. Trans. Line
74. Cable - Electric
78. Link - Antenna - Long
79. Link - Antenna - Short
80. Strain Insulator
98. M.B.A. Antenna
99. Waxed Linen Thread

AA. IFF SYSTEM

The ABK installation of the IFF system is installed by the Navy although fittings and wiring are installed before delivery (Dwg. 6090-129).

The receiver mounting is at floor level on the port side immediately forward of frame 22. The control unit is bolted to the starboard side of frame 24 at ceiling level. On-off, destructor, and emergency switches are mounted on the pilot's instrument panel. The removable post antenna is mounted on the bottom centerline of the car midway between frames 20 and 21.

BB. RADAR SYSTEM

Provision is made in the car for Radar equipment (Dwg. 6090-5603), although final installation is performed by the Navy.

The beehive assembly is installed in the blister on a sliding rack assembly between frames 11 and 12 so that it may be hydraulically withdrawn into the car when necessary (Dwg. 6090-1467).

The main control box and indicator is mounted on a stand (Dwg. 6090-5900) located on the port side of the mechanic's compartment between frames 11 and 12. A chair is provided for the operator.

A swinging bracket is provided at frame 28 underneath the pilot's instrument panel, for mounting the repeater tube (Dwg. 6090-1310) so that it is available to either the pilot or co-pilot.

A shelf is placed on the starboard side of the car between frames 27 and 28 (Dwg. 6090-7170) and one on the after starboard side of frame 12 (Dwg. 4090-7198) for the two amplifying units.

CC. FUEL SYSTEM

The fuel tank system consists essentially of a forward group of six tanks* located between frames 17 and 20 in the forward car, a middle group of two tanks located between frames 14-15 and 11-12 in the middle car, and an after group of six tanks located between frames 5 and 8, in the after car.

The two tanks located, respectively, between frames 11-12 and 14-15 nearest the center of the car, are used as service tanks.

The four tanks* located between frames 17 and 19 are designated as storage tanks.

* The two storage tanks between frames 17-18 were not installed, although included at delivery for airships M-2, M-3 and M-4.

The four tanks located between frames 19 and 20, and 6 and 7, respectively, are slip tanks. The slip tanks can be released completely from the ship in an emergency by electrical release controls on the pilot's instrument panel. The slip tanks can be coupled quickly to the fuel supply system by a length of flexible synthetic rubber hose equipped with "Snap-tite" couplings.

The two tanks between frames 7 and 8, and the two tanks between frames 5 and 6 are equipped with dump valves and serve as dump tanks. The four dump tanks spill through 4-inch dump lines on the port and starboard sides of the car between frames 5 and 6, and 7 and 8. The dump valves are controlled from the pilot's instrument panel. Improved extension jet pipes were installed on the dump lines for M-4.

The fuel system is so arranged that only the service tanks may normally feed directly to the main engines. All other tanks in the system must feed the engines through the service tanks. An auxiliary cross connection is provided in the system to permit any tank to feed the engines in level flight.

A manually operated Romec wobble pump, located in the main fuel transfer assembly on the starboard side at frame 13, permits fuel to be transferred either fore or aft, or into the service tanks (Dwgs. 6090-62, 4090-810). On M-4 only, an electrically driven transfer pump is mounted in series below the Romec wobble pump.

One filling connection for the system is provided at frame 13 below the deck level. It consists of a flexible 1-inch filler hose coupled to the main fuel transfer system and is equipped with a 1-1/2-inch Barrett coupling with cap. The flexible filler connections terminate below frame 13, in the landing wheel well, and is readily accessible at that point through the blister trap door, located between frames 12 and 13.

A line strainer is installed in the fuel line between the Barrett coupling and the first fuel line valve to insure that the fuel will be free of foreign material.

Each tank is equipped with a "Triumph" fuel gauge, Model 106-01, and a corrosion inhibiting cartridge, with a drain cock in the gauge well. All the tanks except the service and slip tanks have a single line connecting them at the bottom center with the fuel line. This line serves as both a filling and servicing feed line. The two service tanks have two line connections on each tank, one on the top and one on the bottom. The top line connects to the Romec wobble pump in the main fuel transfer assembly, while the bottom line connects into the main feed lines to the engines.

One connection is made at the top of each tank for venting. Each tank

vent connects into a common vent line running overhead along the longitudinal centerline of the tanks. The forward car vent lines vent to port and starboard between frames 17 and 18; the middle car vent lines vent at frame 11 on the port side; and the after car vent lines vent at frame 2 on the port and starboard sides. (Dwgs. 6090-71, -72, -73).

All fuel tanks in the system are 30-inches in diameter, 125-gallon capacity, and have two transverse baffle walls to prevent excess fuel motion.

All tanks are located symmetrically about the longitudinal centerline of the car. They are mounted in the triangular truss structure formed by the main horizontal transverse member and the diagonal braces of each car frame. (Dwgs. 6090-61, -62, -63). All fuel tanks except the slip tanks are rigidly supported in the car structure by a system of supporting straps and wires. (Dwgs. 6090-67, -68, -69, -70). The slip tanks are suspended on Mark 3 electric bomb shackles and held in position by a system of straps, wires and exerciser cord (Dwg. 6090-66). The electrical bomb shackle release controls are mounted on the pilot's instrument panel. When the slip tank release control is actuated, the bomb shackles release the tank and permit it and its supporting system of straps and wires to fall from the ship. The section of the car covering immediately adjacent to the slip tank is hinged and swings outward, thus allowing the tank to fall free of the ship, and is then closed by exerciser cord.

Each engine is provided with a spline shaft, engine-driven fuel pump, equipped with by-pass and relief valves, and an emergency auxiliary hand pump. The auxiliary hand pump may be used to feed fuel into the carburetor should the engine-driven pump fail. The manually operated emergency pump forces fuel through the by-pass valve of the engine pump and thence to the engine carburetor. Both engine-driven and auxiliary hand pumps are inter-connected to both engine carburetors through a cross-over line so that either of the engine-driven or hand auxiliary pumps may be used to feed either or both of the engine carburetors.

All valves are of the globe or plug type and are manufactured by the Parker Appliance Company of Cleveland, Ohio. The valves have standard AN pipe threacs suitable for AND 10059 type fittings. All fuel and vent lines are of 52S0 aluminum alloy tubing.

Flexible synthetic aromatic fuel resistant rubber hose connections are used to couple feed lines between car sections. Shut-off valves are installed in the fuel lines before each flexible inter-car connection.

Vent screens cover all vent ports in the car sides.

The general assembly of the fuel system is shown on drawings 6090-1,

-2, -3, -61, -62, -63, while a schematic drawing of the tank layout is mounted on the pilot's instrument panel and a schematic diagram of the system is mounted on a hinged plate on the mechanic's panel as shown in Fig. LXIV.

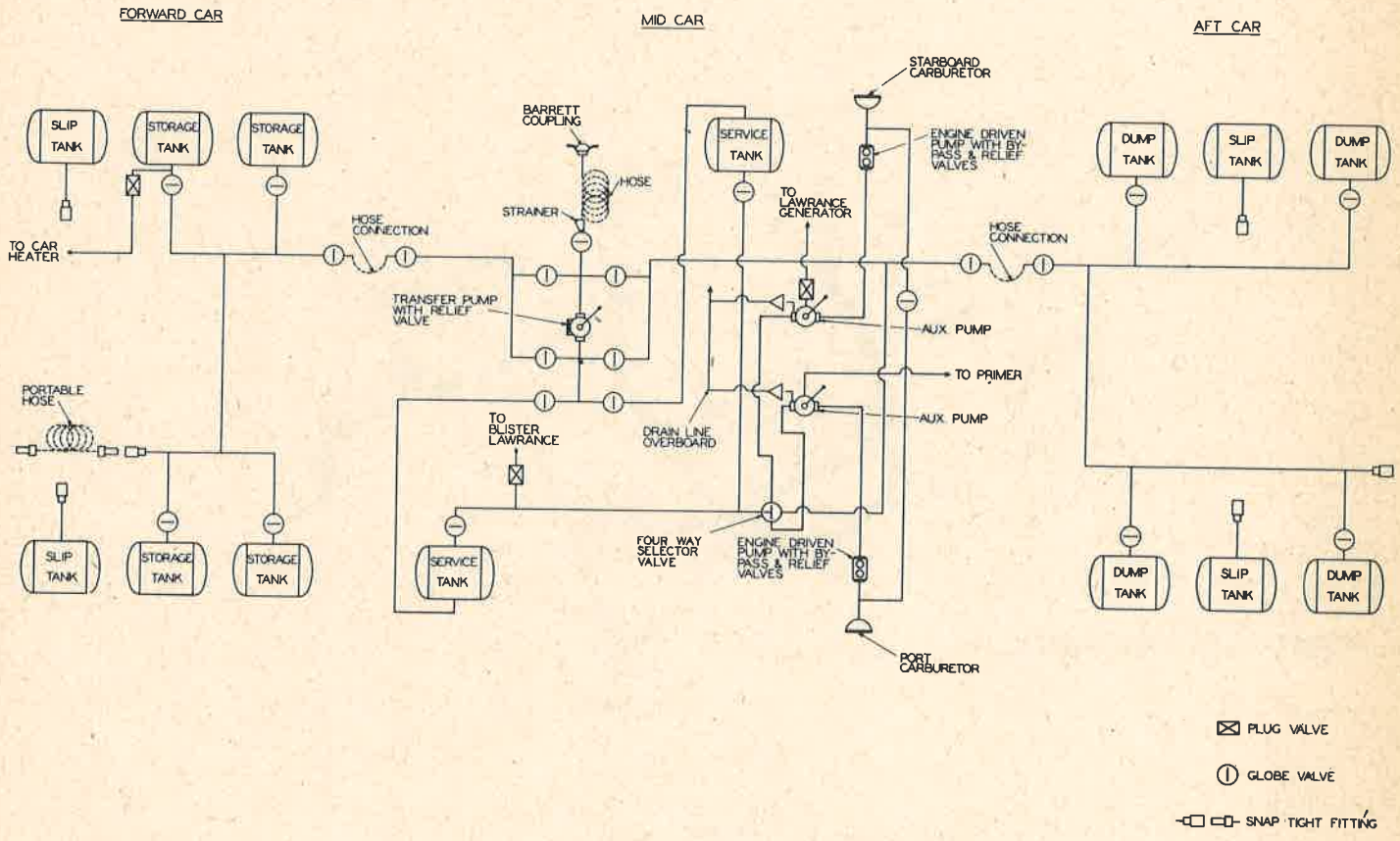


FIG. LXIV - FUEL SYSTEM - SCHEMATIC DIAGRAM

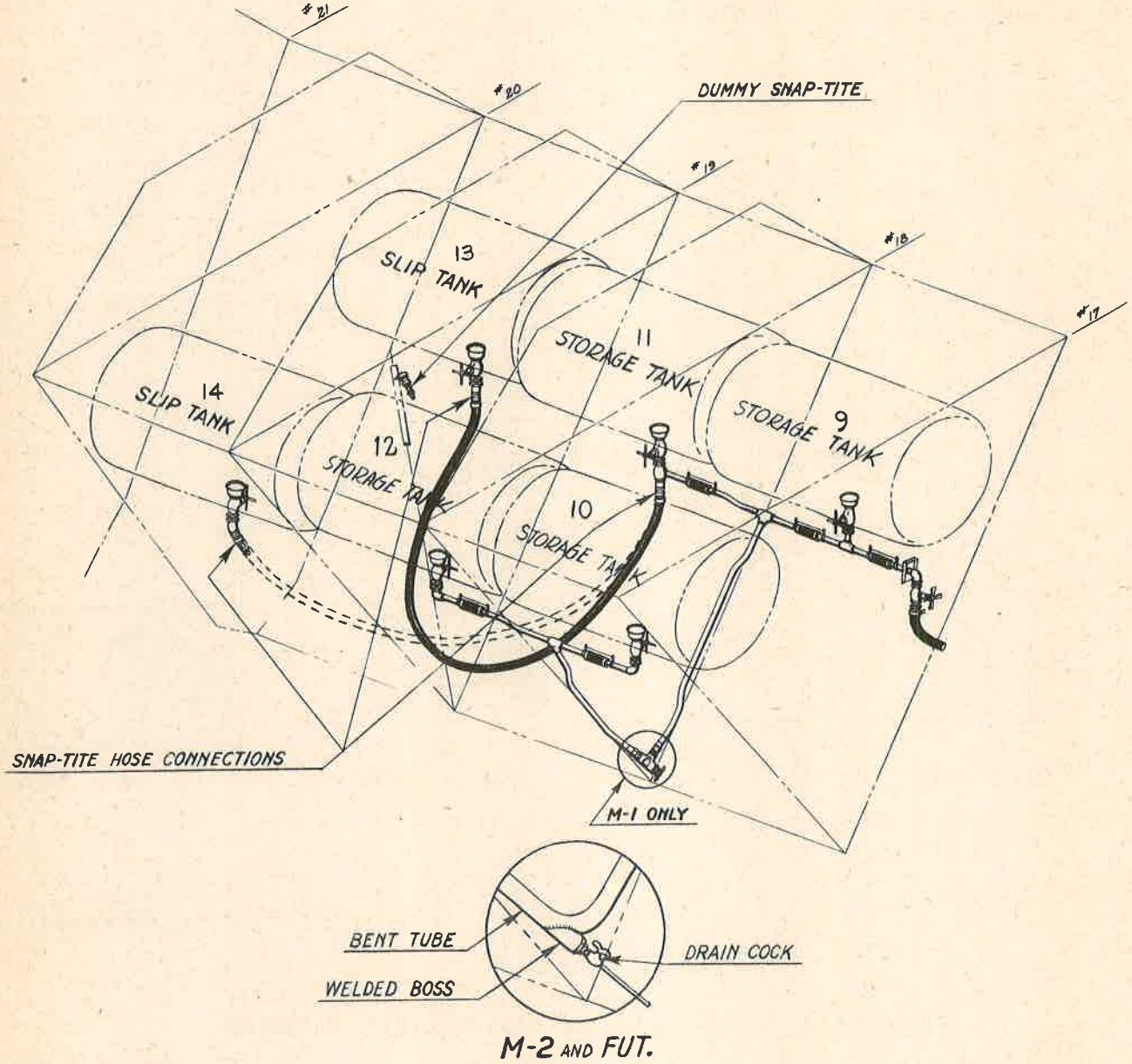


FIG. LXV - FUEL SYSTEM - FORWARD CAR

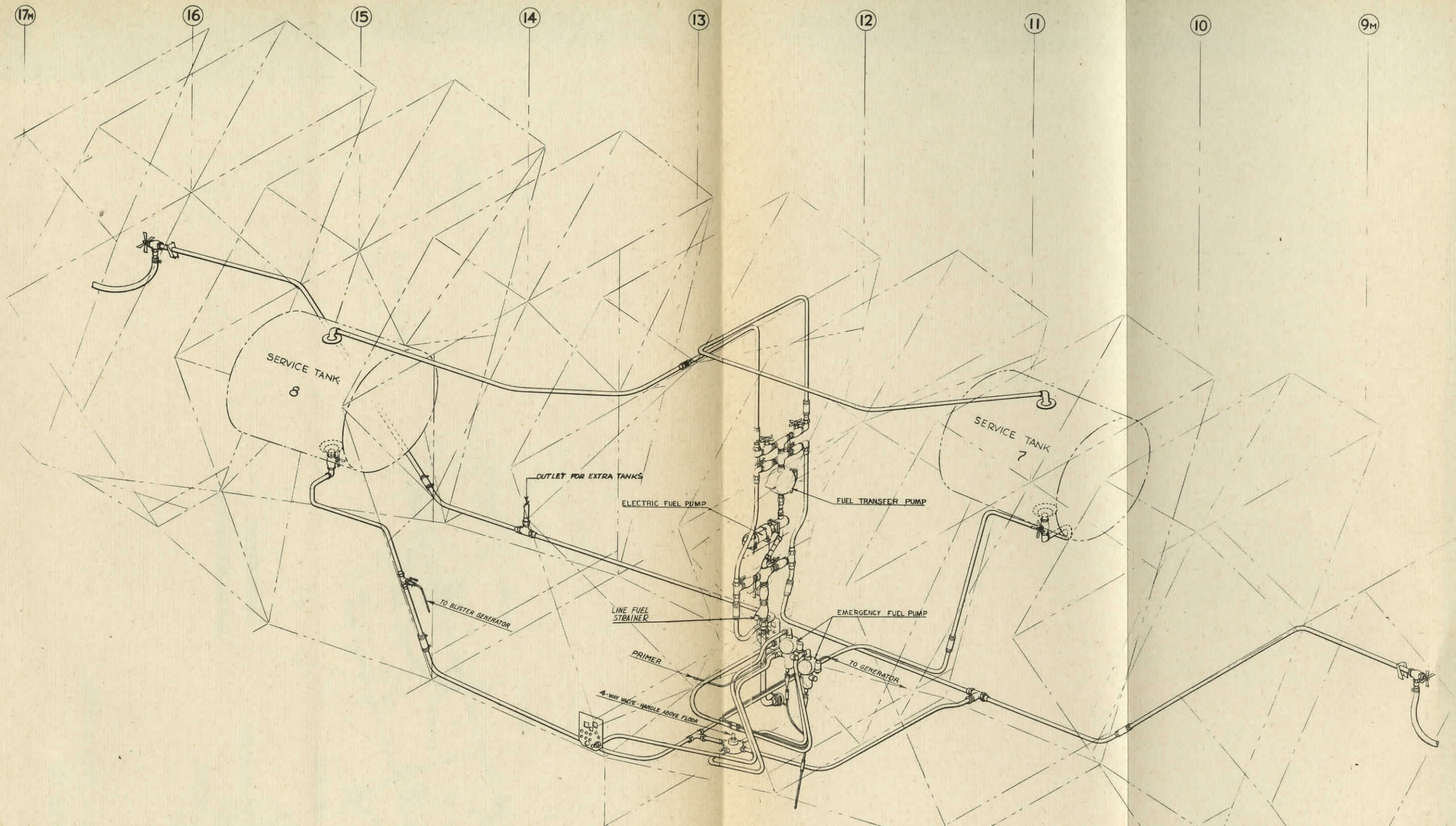


FIG. LXVI - FUEL SYSTEM
MIDDLE CAR

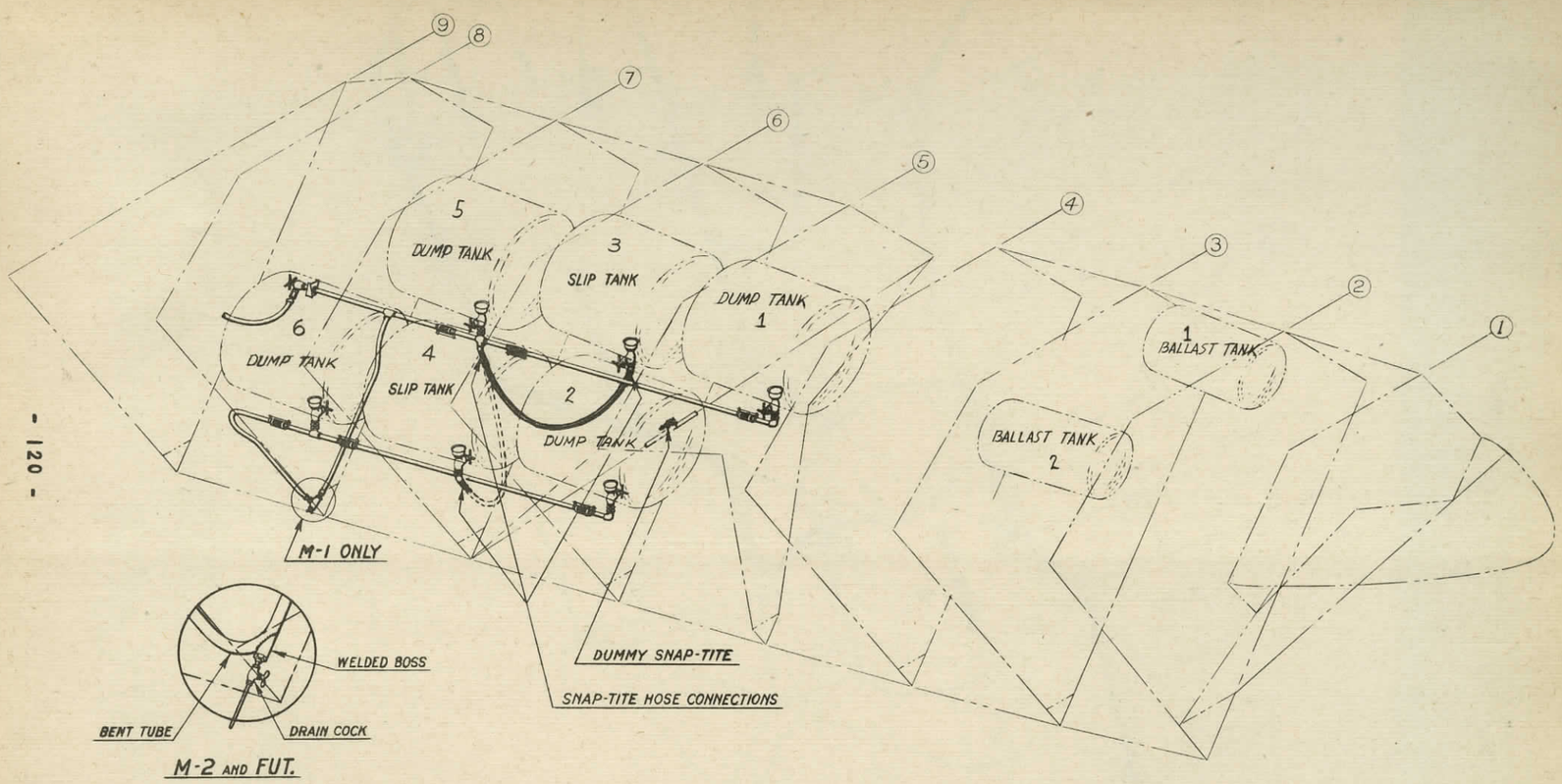


FIG. LXVII - FUEL SYSTEM

AFTER CAR

DD. OIL SYSTEM

The oil system consists of two* 40-gallon oil storage tanks, located symmetrically about the longitudinal centerline of the car between frames 13 and 14, two 10-gallon usable capacity (14-gallon total capacity) oil service tanks located in the engine nacelles, two oil coolers built into the leading edge of the lower outriggers, and all necessary piping and fittings to complete the system. (Dwg. 6090-56).

The two* 40-gallon oil storage tanks (between frames 13 and 14) are in the upper car structure, on the port and starboard sides, respectively, and are mounted just below the main transverse brace in the car frame structure. They vent out of their respective sides of the car (Dwg. 6090-72). Each tank is of aluminum alloy construction, 18-inches in diameter, and is equipped with a Triumph magnetic type gauge. The tanks are filled from inside the car through a common fill line connection located on the starboard aft side of frame 14.

A manually operated United Aircraft Products wobble pump, Model U-200-CV is installed in the oil line system on the starboard aft side of frame 14 (Dwg. 6090-56). By means of this pump and suitable valve regulation of the 3-way valves in the system, oil may be transferred from one storage tank to the other, or pumped from either oil storage tank to either or both of the oil service tanks in the engine nacelles. (Dwg. 6090-56)

The oil lines from the transfer pump connect to the outrigger service tank lines on the port and starboard sides, respectively, at ceiling level aft of frame 12.

Each oil storage tank is provided with a plug valve in the drain line at the bottom of the tank. Each tank line connects to a common drain cock, located below the deck level, on the car centerline at frame 14.

The 10-gallon oil service tank in each engine nacelle (Dwgs. 6090-74, -147) is constructed of aluminum alloy, and is 15-inches in diameter. Each tank is equipped with a Moto-meter RKD remote reading gauge, which has its indicator on the mechanic's instrument panel. In addition, each tank is provided with a sounding rod. The tanks have fittings for oil immersion heaters, two 1000-watt heaters being supplied with each ship.

The service tanks may be filled from either the inlet feed line from the storage tank system, or through an opening in the tank itself, capped with an NAF filler unit. The tanks are vented to the crankcases of their respective engines.

* The port oil tank was included at delivery, although not installed, for airships M-2, M-3 and M-4.

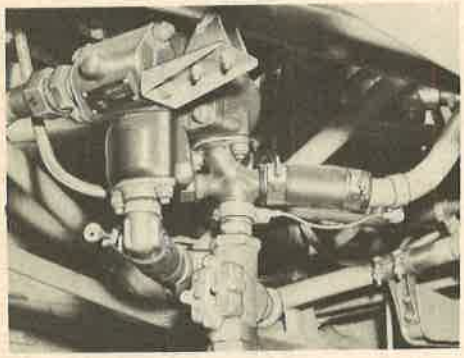
Engine-driven Thompson oil pumps are installed on each engine for circulating the oil from the oil service tank through the engine.

Each engine is equipped with an 8-inch oil cooler, United Aircraft type U6008-530, located in the leading edge of the respective lower outrigger cowling. (Dwg. 4090-699 for M-1; 4090-5728 for M-2 and Future).

The oil cooler is built completely within the lower outrigger cowling. The air intake is flush with the leading edge of the cowling (Dwg. 6090-5) and the air exhaust is through metal ducts (Dwg. 6090-700) to the upper and lower rear sides of the outrigger.

The oil temperature is regulated by a P & W Oil Temperature Regulator in the oil feed lines. A well for an oil temperature element and an oil pressure connection is provided for each engine.

All oil lines are made of 52S0 aluminum alloy tubing.



DETAIL "A"

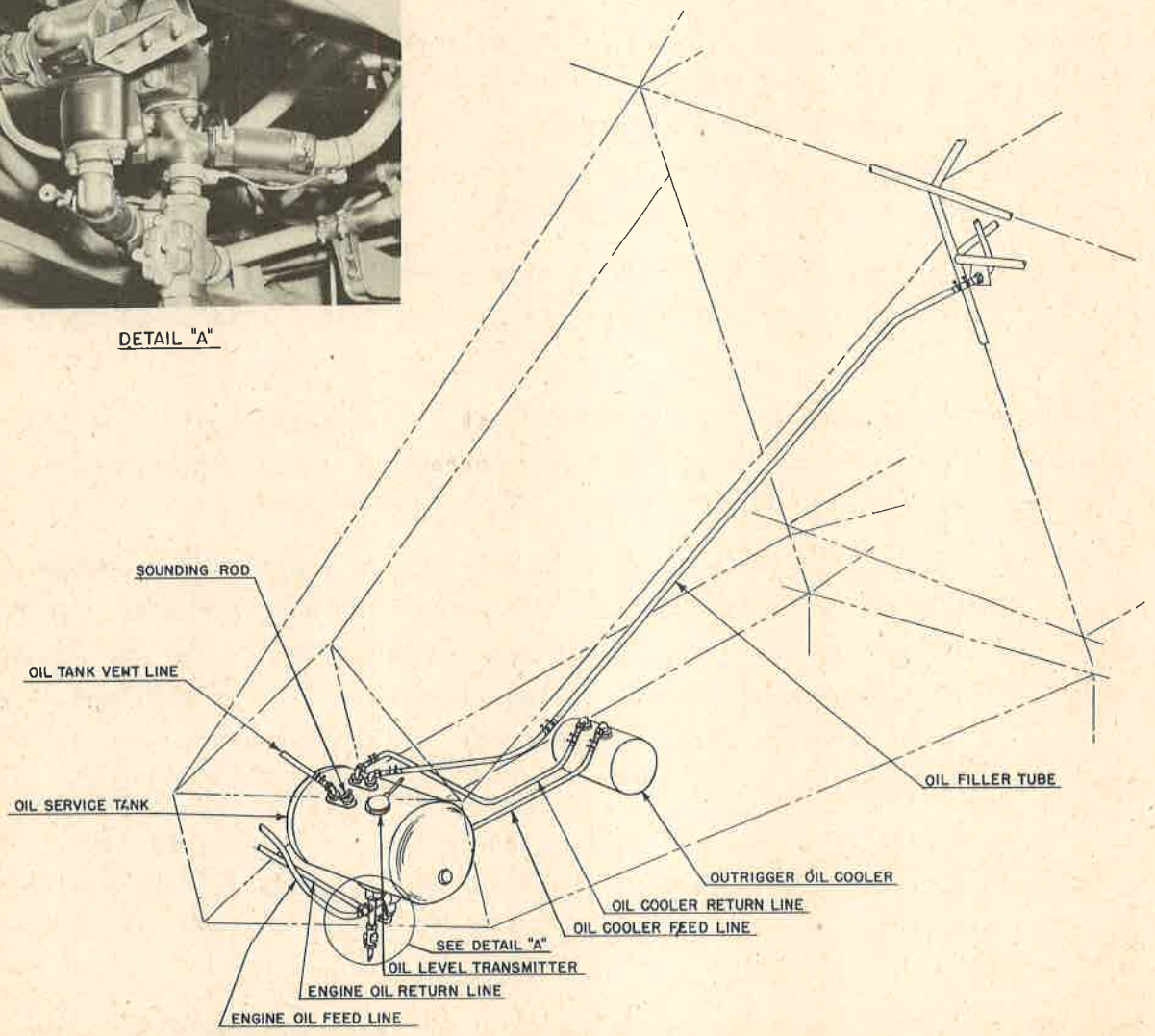


FIG. LXVIII - OIL SYSTEM IN OUTRIGGERS

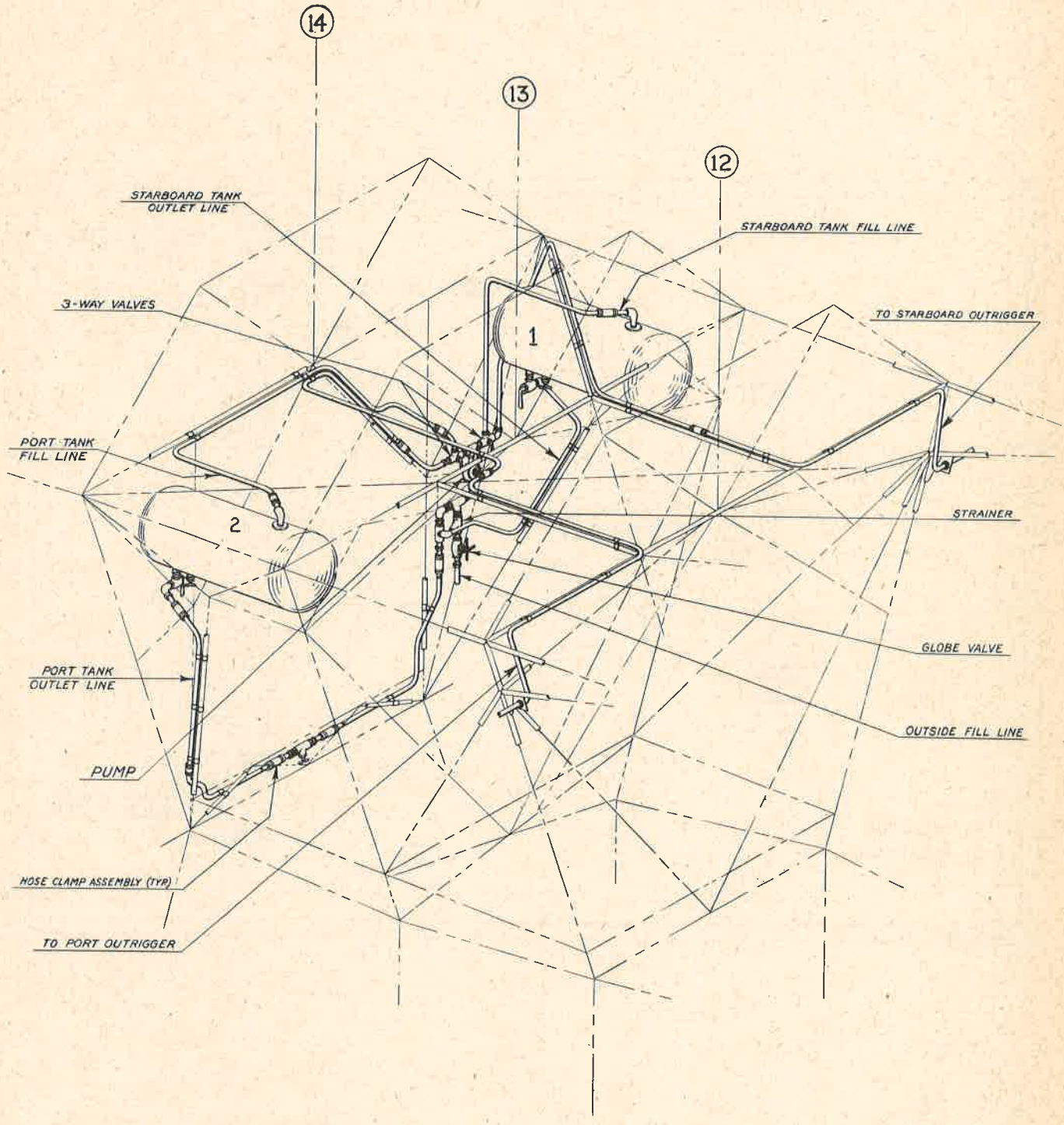


FIG. LXIX - OIL SYSTEM IN CAR

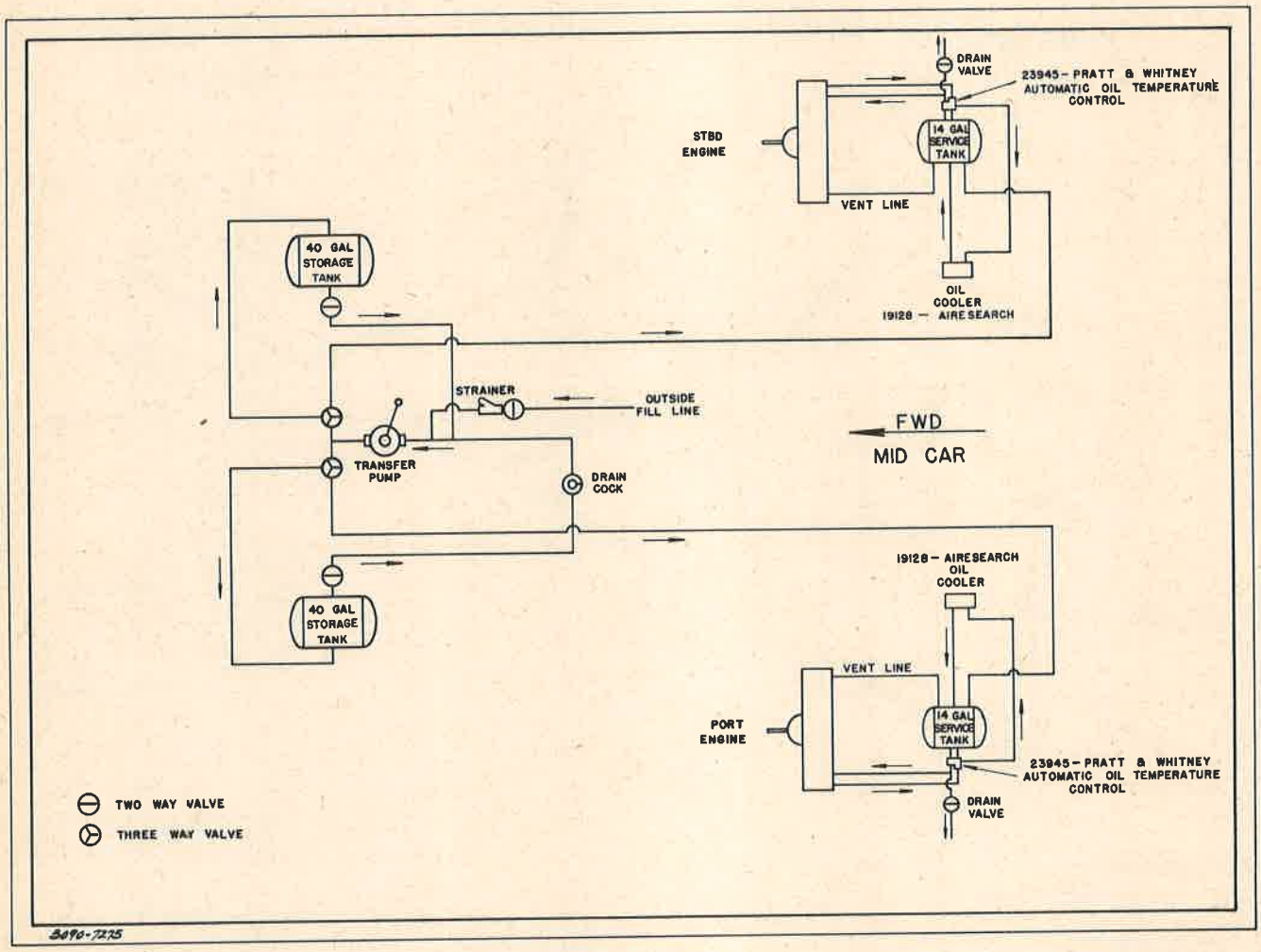


FIG. LXX - OIL SYSTEM - SCHEMATIC DIAGRAM

EE. BALLAST SYSTEM

In addition to the ballast provided by the fuel tank system, there is a water ballast system consisting of four* aluminum alloy tanks with all necessary piping and fittings to complete the system. The four ballast tanks, each with a capacity of 40-gallons, are located symmetrically about the longitudinal centerline of the car in the car roof structure between frames* 2-3 and 21-22, respectively. A dump valve installed at the bottom of each ballast tank is controlled by release controls on the pilot's instrument panel. (Dwgs. 4090-605, 6090-71, -73, -123). The ballast dump valves discharge through their respective tubes on the port and starboard sides of the car. These dump tube outlets are located below the car fairing, between frames 21 and 22, and 2 and 3. The tanks have vent connections at top. The tanks are filled through "quick-disconnect" inlets located on the starboard side at frames 3 and 22. A remote reading gauge is installed in each tank and the indicator itself is mounted on the pilot's instrument panel.

* The two after ballast tanks were included at delivery although not installed for airships M-2, M-3 and M-4.

FF. FIRE EXTINGUISHING SYSTEM

A fire extinguishing system is provided for both the main engines and the Lawrance generators. A compressed CO_2 Type K, fire fighting system, manufactured by American LaFrance and Foamite Company, is used for the main engines.

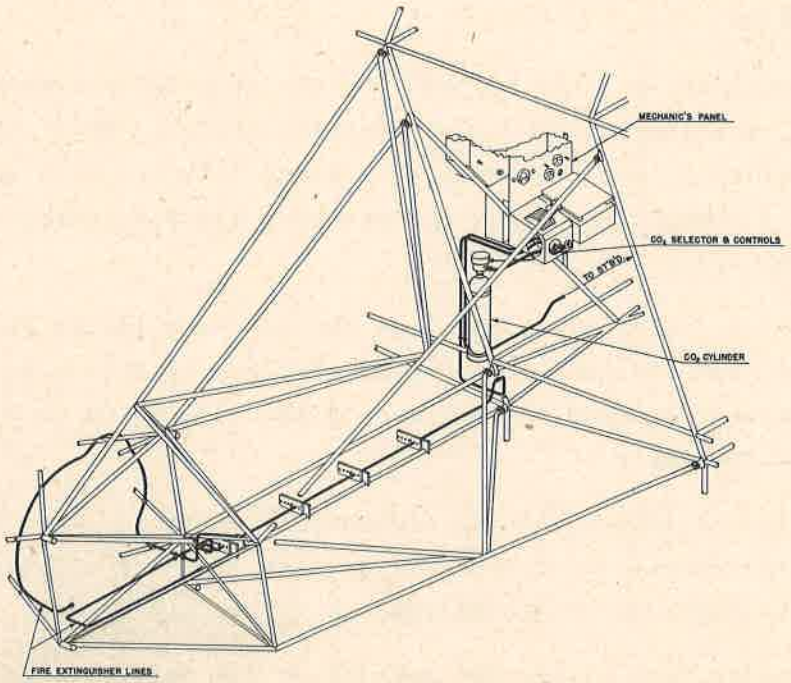


FIG. LXXI - FIRE EXTINGUISHING SYSTEM

The engine equipment is provided with a manual release mechanism. The manual release toggle and selector located on the mechanic's instrument panel, are connected to the equipment through a pulley and cable system.

From the fire equipment control unit, 1/2-inch by .042-inch aluminum alloy tubes are run through the lower engine outrigger cowling to each engine nacelle. In each nacelle, the tubing is attached to the engine mounting frame, forming a circle at the forward end of the nacelle, with extension tubes extending aft along each side of the nacelle. The tubing inside the nacelle is perforated to permit the escape of CO_2.

The Lawrance generators are each provided with a separate automatic Kidde Luxstat Extinguisher System, Model A394, which utilized compressed CO_2. It is released automatically by thermal valves in case of fire in the generators, or manually by a toggle located at each control unit.

In addition to the foregoing fixed systems, four Kidde Lux Portable Hand Fire Extinguishers, mounted on brackets, are provided as follows:

LOCATION	TYPE
Port side of car between frames 3 and 4	2A
Port side of car between frames 10 and 11	5A
Starboard after side of frame 22	2A
Port forward side of frame 26	2A

GG. HEATING SYSTEM

The forward car heating system consists of a Stewart-Warner Southwind carburetor type, gasoline, hermetic combustion heater. Model EX-24975 was originally installed on M-1; EX-25203 on M-2 and future. This heater is equipped with a sirocco type blower driven by a 3/4-H.P. electric motor. (Dwgs. 6090-1265, -7732, -1414).

The gasoline supply is taken from the car fuel system by means of a special line and Adel electric pump. Fuel pressure is maintained constant by means of a pressure regulator connected into the line so as to by-pass fuel from the pump as necessary.

The heater is located on the starboard side of the car, between frames 21 and 22, and is enclosed by a protecting guard, the top of which forms a table surface 48-inches by 26-inches for use by the galley cook.

Air is taken from either the outside or inside of the car and delivered by means of aluminum alloy ducts covered with "Rub-Bub" insulation, to regis-

ters located in the car deck as follows:

Between frames 22 and 23
Between frames 24 and 25
Between frames 26 and 27

Normal operation is automatic. On-off switches for the blower and for the heater are mounted in a junction box on the forward starboard side of frame 21. These switches are inter-connected so that the blower may be operated without the heater for circulating fresh air, but the heater cannot be operated without the blower.

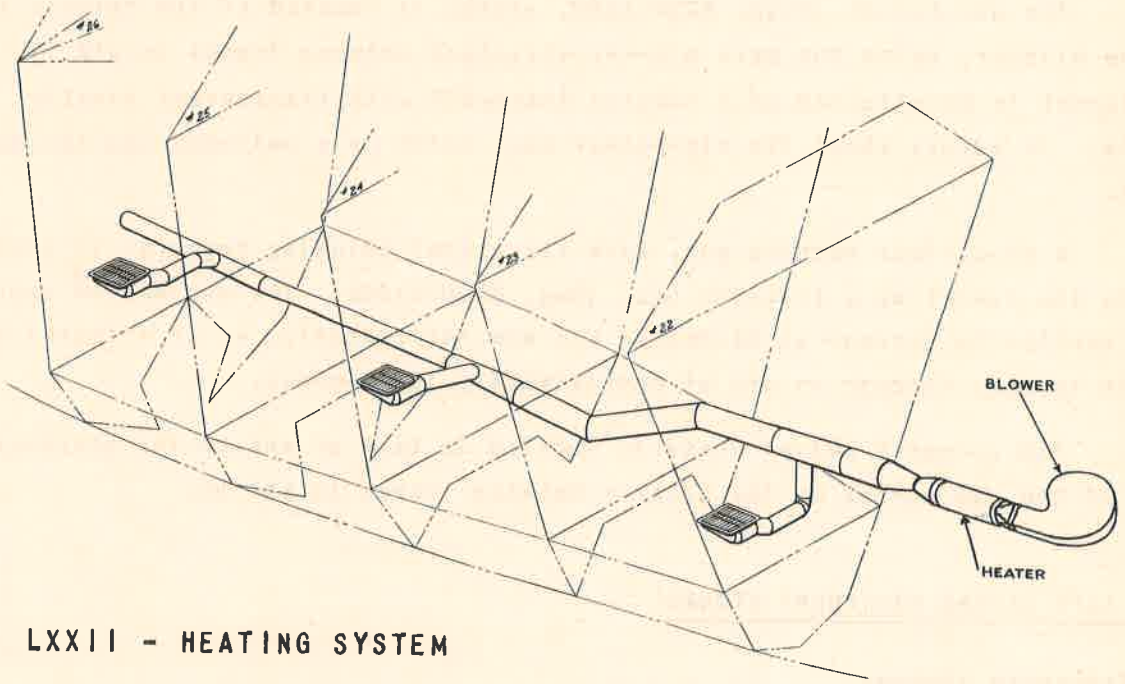


FIG. LXXII - HEATING SYSTEM

HH. ARMAMENT PROVISIONS

1. Bomb Racks

Four bomb racks are located in the forward bomb bay (Dwg. 6090-1350). The two between frames 22-23 are vertically mounted on a horizontal plane, the two between frames 24-25 are vertically mounted in a position slightly inclined from the horizontal. Fixed anti-sway braces are incorporated in the assembly. The four bomb racks in the after bay between frames 5 and 5A are mounted in vertical planes on supporting channels mounted in an inclined plane. (Dwg. 6090-1334).

Electrical bomb release controls, providing individual, salvo or train release for the eight depth charges in the forward and after bomb bay are located on the bombardier's panel. The release controls are connected electrically to the Mark 51-7 bomb shackles supporting the depth charges. Manual

emergency release toggles are mounted on each of the after bomb shackles; and on the forward starboard side of frame 24 in the radioman's compartment for the forward bomb shackles. Electric controls on the bombardier's panel are provided for the operation of the bomb bay doors (Dwgs. 6090-1, -1308 and 6P-1253).

The depth charges, Navy type MD "A" (Ordnance Dwg. #227507) and the bomb shackles are furnished by the Navy.

2. Gun Turret

The gun turret (Dwgs. 6090-1300, -1303) is located at the forward end of the blister, below the main mid-car structure between frames 15 and 16. The turret is constructed of a tubular framework with transparent plastic panels. It pivots about its mid-center base point on a ball-bearing equipped shaft.

A 50-caliber machine gun, with its barrel pointing forward, is mounted within the turret on a trunnion base (Dwg. 6090-1300). The gun may be swung down vertically through an 80-degree arc and horizontally, as an integral part of the turret, through an arc of approximately 120-degrees.

The gunner's swivel chair is located in back of and to the starboard side of the gun turret in the blister between frames 14 and 15.

II. LIFE SAVING EQUIPMENT STORAGE

1. Parachute Storage

Provision is made for the storage of two parachutes; one on the port side forward of frame 26 (Dwg. 4090-7410); one on the starboard side forward of frame 2 (Dwg. 2090-7419). Supporting angles and channels of 24ST Alclad are installed where necessary, the parachutes being so retained by a single length of 5/16-inch exerciser cord as to be quickly removable.

2. Life Raft Storage

A support for a life raft is installed on the starboard side of the car between frames 3 and 4 (Dwg. 2090-7422). This support is constructed of 24ST Alclad channel, a steel brace wire, and the supporting web of straps for the raft.

3. Life Jacket Storage

A total of five life jacket containers are installed in the car at the

following locations:

1. Port side between frames 3 and 4 (1). (Dwg. 2090-7414).
2. Port and starboard side between frames 9 and 10 (1). (Dwg. 2090-7415)
3. Port side between frames 22 and 24 (3). (Dwg. 4090-7416)

The containers (Dwg. 6092-548), each of which has three pockets, are constructed of fabric and secured in place by Cord-O-Hyde lacing.

JJ. SANITARY EQUIPMENT

The sanitary equipment (Dwg. 6090-1275) is located in the mechanic's compartment immediately aft of frame 14 and consists of the following:

Item	Mfg. and Part No.
Paper Towel Holder	Federal Paper & Twine Company
Toilet Paper Holder	Dayton Mfg. Company Cat. No. 2
Liquid Soap Holder	" " " Cat. No. 33 1/4
Soiled Towel Rack	" " " Cat. No. 29 1/2
Water Tank	" " " Cat. No. 463
Wash Stand	" " " Cat. No. 983A
Chemical Dry Closet	" " " Cat. No. 58 1/2

The wash stand drains to the outside through a 1-inch O.D. aluminum alloy tube. The toilet is vented to the outside by means of an aluminum alloy vent pipe and streamlined ventilator cover (Dwg. 1090-8142 and 2079-1115). None of the above items, except the closet and toilet paper holder, are installed at delivery but are included for future installation if desired. All items are so installed by the use of screws, bolts or clamps as to be easily removable.

KK. SINK DRAIN BAG

A sealed, cylindrically shaped drain bag (Dwg. 4092-666) approximately 1-foot high by 1-foot in diameter is suspended beneath the deck immediately aft of frame 22 and accessible from the forward bomb bay opening. The bag is constructed of fabric per Spec. N-128A5 and is suspended by means of three straps, hooked to fittings on the car structure so as to be quickly removable. It is connected to the sink by rubber and aluminum drain and vent tubing. A fabric tube is attached to the bottom center of the bag for emptying.

LL. REFUSE CONTAINER

A refuse container is attached to the after port side of frame 21

(Dwg. 4090-7520). The refuse container (Dwg. 2080-920) is constructed of rubberized fabric suitably reinforced. It is suspended from a metal clip by means of a cotton cord harness and held in position by an encircling metal band bolted to the car frame.

MM. CHAIRS

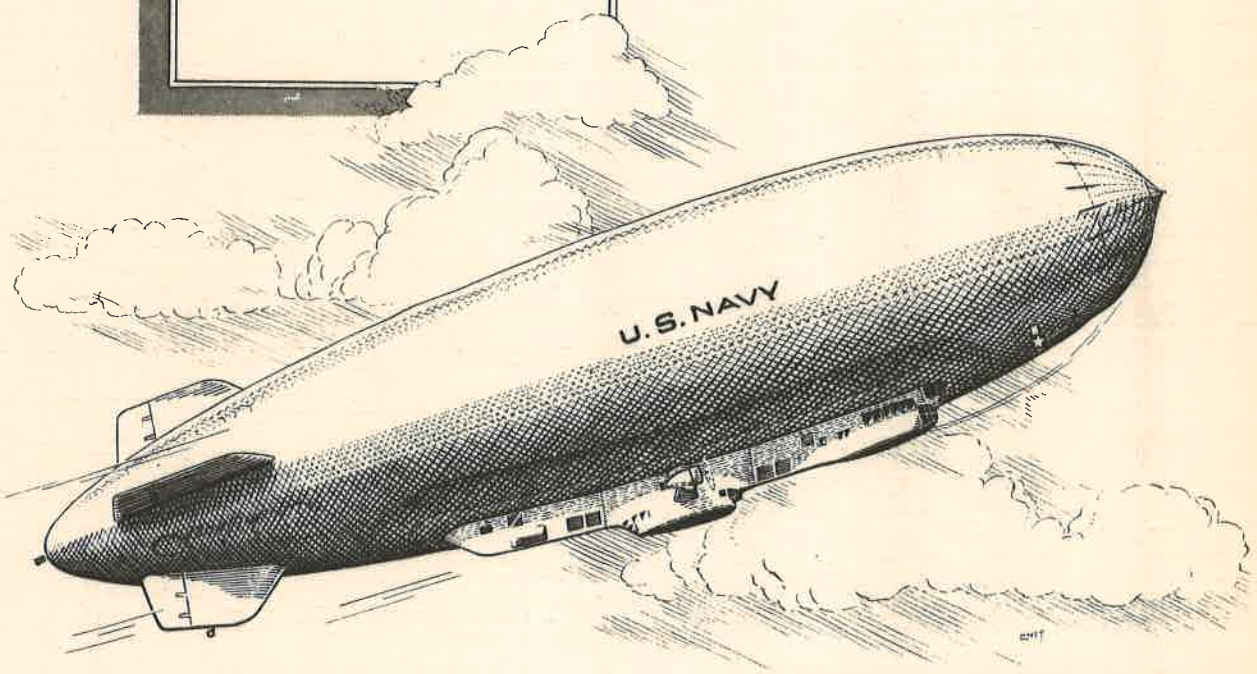
Six aluminum alloy adjustable swivel arm-chairs with seat cushions are furnished for the co-pilot, radio operator, mechanic, Radar operator, observer and machine gunner, at their respective stations. The chairs are manufactured by the General Fireproofing Company of Youngstown, Ohio (Dwg. CR7561). A Warren McArthur type #150 chair is provided for the elevator pilot. The bombardier is provided with a fixed legless wooden chair (Dwg. 4090-1309) in his compartment, while the navigator and commander are each provided with an aluminum alloy stool (Dwg. 3079-530-1).

NN. PYROTECHNIC PISTOL

A pyrotechnic pistol AN-M-8, and two cartridge cases are provided at ceiling height on the port side of the car just forward of frame 24. An opening and blast tube in the car side for insertion and discharge of the pistol is made between the two cartridge boxes. When not in use, the signal gun is clipped to the cartridge case (Dwg. 4090-1312).

Part V

Appendix



Goodyear "M" Airship

Part V

Appendix

- APPENDIX -

A. PROTECTIVE FINISHES

1. Anodizing:

(a) All aluminum and aluminum alloy parts fabricated from 17ST, 24ST, aluminum alloy castings containing 5% or less of copper, and all aluminum and aluminum alloy parts in the fuel system are anodized by the chromic acid process.

(b) In place of the anodizing of all other aluminum alloy parts, the chromic acid dip G.A.C. process Spec. P-5 is used before application of any paint.

The exception to the above anodizing requirement is that such parts that are used in electrical connections are exempt from such treatment.

2. Faying Surfaces

The general requirement for all faying surfaces is that at least two coats of primer are applied to the detail part before sub-assembly, except all machined parts with bearing surfaces and other closely held dimensions are anodized only. Lacquer on faying surfaces is undesireable because of its brittleness and lack of inherent corrosion resistance.

3. Painting Schedule:

Aircraft Grey Lacquer	Spec. AN-TT-L-51
Non-specular Grey Lacquer	Spec. M485
Dull Dark Green Lacquer	Spec. AN-TT-L-51
Thinner	Spec. AN-TT-T-256
Zinc Chromate Primer	Spec. P27-B-2
Instrument Dull Black	Spec. AN-TT-L-51-1
Tinted Zinc Chromate Primer	See Note

NOTE: How to mix tinted zinc chromate primer: 2-oz. of Indian Red Paste, Spec. TT-I-511l mixed in three gallons of thinner, Spec. AN-T-8-A, stir thoroughly then add 1-gallon of zinc chromate primer P27-B-2.

NOTE: Thinner Spec. AN-TT-T-256 is used in non-specular and aircraft grey, dull dark green for spray painting.

4. Finish Application

(a) Car Structure

One coat of zinc chromate primer
One coat of light grey semi-gloss lacquer

That portion of the car in the pilot's compartment between the

deck and the ceiling is painted dull dark green lacquer instead of grey.

(b) Outrigger Structure and Engine Mount

One coat of zinc chromate primer
One coat of tinted zinc chromate primer

(c) Landing Wheel (Structural)

One coat of zinc chromate primer
Two coats of non-specular grey lacquer

(d) Above Ceiling

1. Parts other than tanks

One coat of zinc chromate primer
One coat of tinted zinc chromate primer
Both coats applied before any sub-assembly.

2. Tanks above ceiling

One coat of zinc chromate primer
One coat semi-gloss grey lacquer

(e) Below the Deck Line

1. Parts other than tanks

One coat of zinc chromate primer
One coat of tinted zinc chromate primer
Both coats applied before any sub-assembly.

2. Tanks below deck

One coat of zinc chromate primer
One coat of semi-gloss grey lacquer

(f) Between Deck and Ceiling

One coat of zinc chromate primer
One coat of tinted zinc chromate primer
Both coats applied before sub-assembly
One finish coat of light grey semi-gloss lacquer
In the pilot's compartment dull dark green lacquer replaces grey lacquer.

(g) Parts Enclosed in Outrigger

1. Parts other than tanks

One coat of zinc chromate primer
One coat of tinted zinc chromate primer

2. Tanks (exterior)

One coat of zinc chromate primer
One coat of semi-gloss grey lacquer

(h) Nacelle, Cowlings, etc.

1. Inner surfaces

One coat of zinc chromate primer
One coat of tinted zinc chromate primer
Both coats applied before any sub-assembly

2. Outer surfaces

One coat of zinc chromate primer
Two coats of non-specular grey lacquer

3. The inner surface of scoops is finished with non-specular grey lacquer.

(i) Car Skin

1. Inner surfaces

a. Below deck or above ceiling

One coat of zinc chromate primer
One coat of tinted zinc chromate primer

b. Between deck and ceiling

One coat of zinc chromate primer
One coat of semi-gloss grey lacquer

2. Outer surfaces

One coat of zinc chromate primer
Two coats of non-specular grey lacquer

(j) Furniture and Inside Hardware

One coat of zinc chromate primer
One coat of semi-gloss grey lacquer
This requirement for purchased items obtained commercially.

(k) Instrument Panels

One coat of zinc chromate primer
One coat dull black

(l) Fin Structure

One coat of zinc chromate primer
One coat of tinted zinc chromate primer
Both coats applied before sub-assembly.

(m) Fin Hardware

One coat of zinc chromate primer
Two coats of non-specular grey lacquer

(n) Envelope Accessories Outside Envelope
One coat of zinc chromate primer
Two coats of non-specular grey lacquer
The faying surfaces of such parts are given two coats of primer before sub-assembling, before application of the color coat.

(o) Envelope Accessories Within the Envelope

One coat of zinc chromate primer
One coat of tinted zinc chromate primer

(p) Before application of paint, steel parts are cadmium plated.

(q) All wood parts are varnished (one coat) and finished with a coat of grey lacquer.

B. PRODUCTION DRAWINGS AND MAJOR ASSEMBLIES

1. Envelope

ACCESSORIES - Inside Envelope	M-1 only	5092-37
" " "	M-2 only	5092-637
" " "	M-3 & Fut.	5092-837
" - Outside "	M-1 only	6092-32
" " "	M-2 only	6092-632
" " "	M-3 & Fut.	6092-832
" - Fin	M-1 & M-2	4092-82
" - Fin	M-3 & Fut.	4092-824
" - Nose Stiffening	M-2 & M-3	6092-662
" - Nose Stiffening	M-4 only	6092-842
AIRLINE ASSEMBLY - Fwd. Ballonet	M-1 only	5092-64
" " " "	M-2 only	5092-615
" " " "	M-3 & M-4	5092-815
" " Aft. "	M-1 only	5092-61
" " " "	M-2 only	5092-628
" " " "	M-3 & M-4	5092-828
AIRLINE - FWD. LONG	M-1 only	5092-48
" " "	M-2 only	5092-648
" " "	M-3 & M-4	5092-817

1. Envelope (continued)

AIRLINE - AFT. LONG	M-1 only	5092-47
" " "	M-2 only	5092-647
" " "	M-3 & M-4	5092-818
AIRLINE SYSTEM ASSEMBLY	M-2 only	6092-616
" " "	M-3 & M-4	6092-816
AIR SYSTEM IN CAR		6092-143
" MANIFOLD IN CAR		6092-144
BALLONET ASSEMBLY - AFT.	M-1 only	4092-8
" " "	M-2 & Fut.	4092-608
BALLONET ASSEMBLY - MID.	M-1 only	6092-10
" " "	M-2 & Fut.	5092-610
BALLONET ASSEMBLY - FWD.	M-1 only	4092-6
" " "	M-2 & Fut.	4092-606
BATTENS - SHORT	M-1 & Fut.	5092-441
BATTENS - LONG	M-1 & Fut.	5092-442
BOW MOORING - HUB	M-1 & Fut.	4092-373
" " - HOUSING	M-1 & Fut.	3092-374
" " - MOORING CONE	M-1 & Fut.	2092-517
" " - SPINDLE	M-1 & Fut.	2092-518
CABLES - CONTROL - MAJOR	M-1 & Fut.	4092-21
CURTAIN - CATENARY - OUTSIDE SUSPENSION	M-1 only	6092-13
" " " "	M-2 & Fut.	6092-613
" " - INSIDE "	M-1 only	5092-11
" " " "	M-2 & Fut.	5092-612
CURTAIN - CATENARY - FIN - SEAMS B-C & J-K	M-1 only	5092-315
" " " " B-C & J-K	M-2 & Fut.	5092-646
" " " " F-G & N-O	M-1 only	5092-310
" " " " F-G & N-O	M-2 & Fut.	5092-645
ENVELOPE PATTERNS	M-1 only	4092-3
" "	M-2 & Fut.	4092-603
FABRIC DISTRIBUTION - ENVELOPE	M-1 only	6092-4
" " "	M-2 & Fut.	6092-604
FABRICS - TABLE OF	M-1 & Fut.	SK-6-7240
FAIRING - CAR ENVELOPE	M-1 only	5092-26
" " "	M-2 & Fut.	5092-627

I. Envelope (continued)

FAIRING - CAR LACING STRIP	M-1 only	5092-318
" " " "	M-2 & Fut.	5092-626
GUIDE - MAJOR CONTROL LINES	M-1 & Fut.	4093-121
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PANEL - RUDDER PILOT'S - INSTALLATION	6090-5630
PARACHUTE PACKS - AFT, CAR	2090-7419
PARACHUTE PACKS - FORWARD CAR	4090-7410
PARTITION AT FRAME #26	6090-911
PLATFORM AND MAP BOX - BOMBARDIER'S	4090-1307
PLATFORM - OUTRIGGER WORK	3090-7395
POWER PLANT - INSTALLATION	6090-86
PRESSURE TUBE SYSTEM - FORWARD CAR	6090-7893

3. Car (continued)

PYROTECHNIC PISTOL - INSTALLATION	4090-1312
RADAR SYSTEM	6090-5603
RADIO CONTROLS - ELEVATOR PILOT'S	4090-7164
RADIO CONTROLS - RUDDER PILOT'S	4090-7207
RADIO INSTALLATION	6090-5635
RADIO INSTALLATION (M-1 ONLY)	6090-152
REFUSE CONTAINER	4090-7520
REPEATER TUBE	6090-1310
SAFETY BAR - AFT. DOORS	2090-6365
SAFETY BAR - FORWARD DOORS	3090-7490
SANITARY EQUIPMENT - INSTALLATION	6090-1275
SCOOP - AIR BLISTER - ENGINE	6090-890
SCREEN - AIR EXHAUST - AFT. CAR	4090-7576
SCREEN - AIR EXHAUST - FORWARD CAR	4090-7577
SCREEN - EXHAUST - AFT. CAR	3090-809
SCREEN - EXHAUST - FORWARD CAR	3090-877
SHELF - STORAGE - GALLEY	3090-5933
SLIP TANK RELEASE MECHANISM	6090-66
STOOL - NAVIGATOR'S	3079-530-1
STOVE - GALLEY	6090-151
SUSPENSION DETAILS - FUEL TANKS	6090-67
SUSPENSION - OIL TANK - BLISTER GENERATOR	4090-5723
SUSPENSION - OIL TANK - CAR GENERATOR	4090-1204
SUSPENSION - TANKS - AFT.	3090-68
SUSPENSION - TANKS - FORWARD	3090-70
SUSPENSION - TANKS - MID.	3090-69
SUSPENSION - 40-GALLON BALLAST TANK	6090-79
TABLE - GALLEY	6090-5998
TABLE - NAVIGATOR'S - INSTALLATION	4090-1190
TABLE - RADIO	6090-1267
TANK - BALLAST	4090-724
TANK - DUMP	6090-612
TANK - FUEL	6090-764
TANK - OIL - GENERATORS	4090-668
TANK - OIL - SERVICE	6090-147
TANK - OIL - SERVICE - INSTALLATION	6090-74
TANK - OIL STORAGE	4090-723
THROTTLE INTERLOCK (M-1, M-2, M-3)	6090-7140
THROTTLE INTERLOCK (M-4 ONLY)	6090-7840

3. Car (continued)

TUBING - ENGINE ASSEMBLY	6090-78
VALVE INSTALLATION - AIR	6090-767
VALVE INSTALLATION - GAS (M-1 & M-2 ONLY)	6090-644
VENT SYSTEM - AFT. CAR	6090-71
VENT SYSTEM - FORWARD CAR	6090-73
VENT SYSTEM - MID. CAR	6090-77
WATER SUPPLY - GALLEY	6090-5717
WINDOW STORAGE - AFT. CAR	3090-7465
WINDOW STORAGE - FORWARD CAR	4090-7433
WINDOW STORAGE - MID. CAR	3090-7516

C. AIRSHIP SERIAL NUMBERS

The following serial numbers have been assigned to the M-Airships:

AIRSHIP	ENVELOPE	EMPENNAGE	CAR
M-1	D-220	F-161	C-109
M-2	D-352	F-451	C-216
M-3	D-353	F-452	C-217
M-4	D-354	F-453	C-218

D. LIST OF GOVERNMENT FURNISHED EQUIPMENT

EQUIPMENT	PART NO.	REQUIRED AMOUNT
Pratt & Whitney Engines, complete with Carburetors, Magnetos, Oil Pumps, Shielded Ignition Assembly, and Spark Plugs.	R-1340-AN-2	2
Curtiss 3-Blade Propellers, 12-ft. diameter, complete with controls, 2 Spinners and Cuffs.	C-532-F	2
Fuel Pumps	H2-E3	2
Eclipse Starters	429-3A	2
Crank Handles	51575	2
Long Extensions		2
Short Extensions		2
Jaw Dogs		2
Handle Pins		4
Eclipse Starter Solenoids	518-2A & 987-3A	2
Booster Coils	513-7A	2
INSTRUMENTS		
Altimeters	88-A-340	2
Thermometer Bulb	88-B-900	7
Airspeed Correction Cards	88-C-150	2
Compass Correction Cards	88-C-200	2
Clocks	88-C-590	3
Compass	88-C-800	1
Thermocouple Connectors	88-C-1300	4
Manifold Pressure Gages	88-G-700	2
Oil Pressure Gages	AN5772-2	1
Suction Gages	88-G-925	1

- APPENDIX -

EQUIPMENT	PART NO.	REQUIRED AMOUNT
Tachometer Generator	88-G-1375	2
Correction Card Holders	88-H-500	4
Climb Indicator	88-I-725	1
Remote Compass Indicator	88-I-800 (AN5730-2)	1
Directional Gyro Indicator	88-I-970	1
Synchroscope Indicator	88-I-2200	1
Tachometer Indicators	88-I-2500	4
Engine Cylinder Temperature (Dual) Indicator	88-I-2655	2
Thermometer Indicator	88-I-2815	4
Thermometer Indicator	88-I-2865	1
Remote Compass Inverter	88-I-4050	1
Thermocouple Engine Leads	88-L-650	4
Thermocouple Engine Leads	88-L-800-15	3
Thermocouple Engine Leads	88-L-800-25	1
Superheat Meter	88-M-200	1
Gas Elements		1
Air Elements		2
Battery and Box		1
Indicator		1
Lead		1
Thermocouple Gasket	88-T-1060	4
Remote Compass Transmitter	88-T-1950 (AN-5730-3)	1
Pitot-static Tube	88-T-2900	1
Engine Gage Unit	88-U-310	2
Suction Regulating Valve	88-V-395	1
RADIO		
Homing Device Equipment	AN/ARR-2	1 set

EQUIPMENT	PART NO.	REQUIRED AMOUNT
Antenna Fairleads 40"	1063-23	1
ZB Antenna	NAF 48134-1	1
Antenna Reels	21324-1	1
Antenna Weight	21327-1	1
Antenna Wire	29720-2 Model J	500'
Command Set Equipment	ATB/ARB	1 set
Radio Receiver	CRV-46151	3
Radio Dynamotor	CRV-21724	1
Radio Transmitter	CRV-52233	1
Extension Cords 60"	CD-307A	10
Noise Filters	48265	3
Range Filters	68304-1	2
Headsets	HS-33	10
Frequency Meter	LM-10	1 set
Interphone Equipment	RL-24C	1 set
Transmitter Keys	213265-1	2
Marker Beacon Receiver	MBA	1 set
Testing Meter	427	1
Microphones	213264-6	10
Transmitter Equipment (with Reel Antenna)	ATC	1 set
Testing Meter	443	1
IFF Equipment	ABK	1 set
RADAR EQUIPMENT		
Group "A" Parts	AN/APS-2A	1 set
Interconnecting Cables and Fittings.		

- APPENDIX -

EQUIPMENT	PART NO.	REQUIRED AMOUNT
MAD Device Equipment	AN/ASQ-3	1 set
ELECTRICAL		
Batteries	AN-3152	2
Condensers	Type A	1
Generators	NEA-5	2
Reverse Current Relays	3GTR72C-1	2
Voltage Regulators (Eclipse)	1001-4	2
Voltage Regulators (Eclipse)	1260-1	2
Lawrance Auxiliary Power Unit	30D-1	2
ARMAMENT		
Pyrotechnic Pistol	2-P-3499	1
Bomb Hoist Modified 3-H-1035	MK-7, Mod-1	1 (used on M-1 only)
Bomb Racks 3-R-176-70	MK-51, Mod-7	8
Bomb Shackles 3-s-1891-15	MK-3, Mod-2	2
Bomb Shackles 3-s-1891-15	MK-3, Mod-3	2

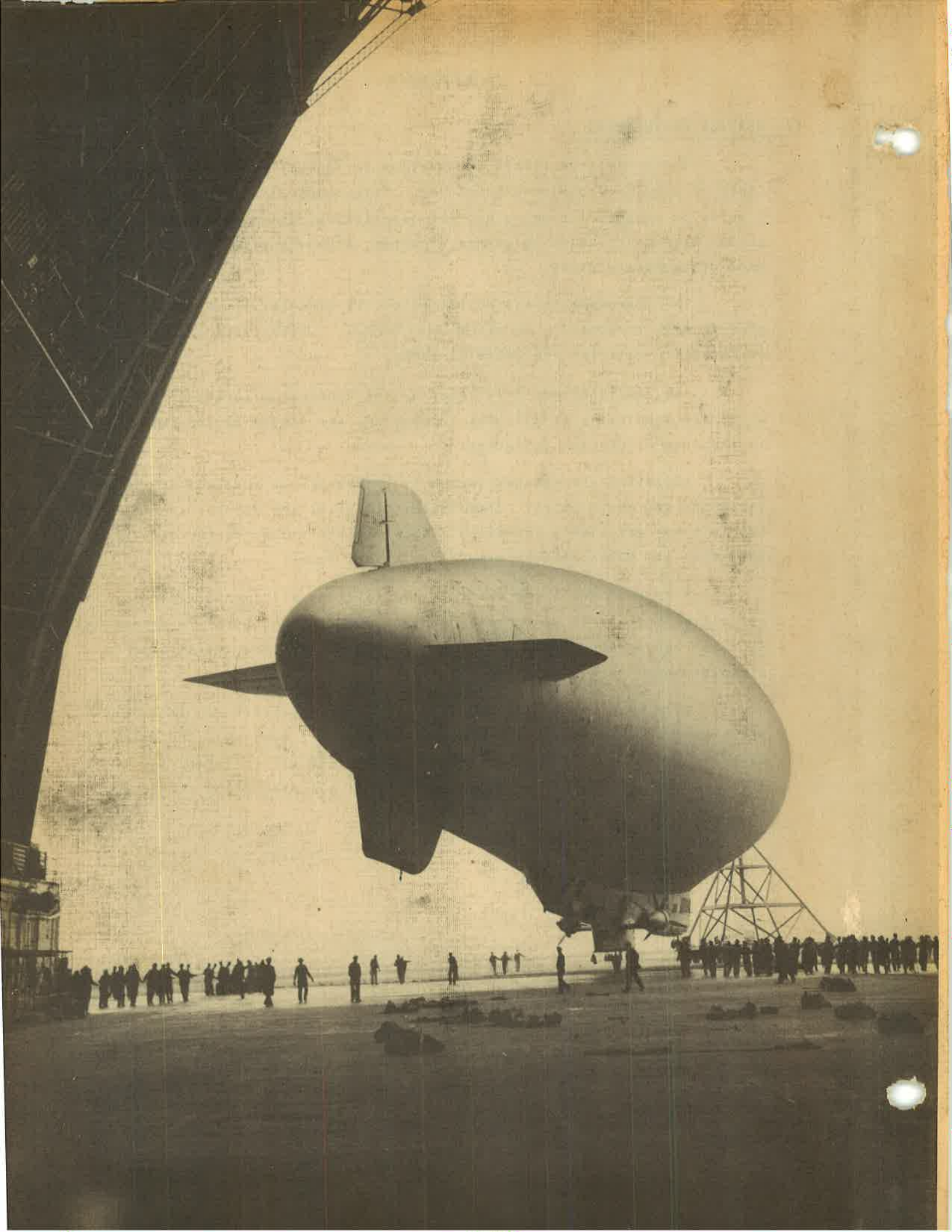
E. SERVICE ENGINEERING

The Goodyear Aircraft Corporation periodically issues a Master Chart of Service Troubles and Changes. This chart lists the source of trouble or changes including a brief description, and denotes the remedial action taken, including reference drawings, airships affected, and shipment of necessary parts.

The improvements and modifications to airships in service, originated by Navy personnel, are called Local Changes. Reports of unsatisfactory or defective material are entitled RUDMs.

The modifications originated by the Goodyear Aircraft Corporation, which are applicable to airships in service, are issued by the contractor in the form of Service Bulletins.

Bulletins and changes issued by the Bureau of Aeronautics are also listed on the above chart. These BuAer Bulletins and changes are of two types, those officially approving a Local Change or Contractor Service Bulletin, and those changes originated by the BuAer.

A copy of the above chart is available at all lighter-than-air activities and should be perused frequently by all personnel in order that they may become acquainted with the latest modifications relative to airship operation and maintenance.

With each airship is included a separate Aircraft Log Book furnished by the U. S. Navy, to which a supplement has been added by Goodyear Aircraft Corporation. This supplement also lists all bulletins and changes, and in addition, furnishes a list of all production changes applicable to that particular airship.